Technical Report 5-32559
Contract No. NAS8-36955
Delivery Order No. 0108
UAH Research Report No.

AUTOMATED PAYLOAD EXPERIMENT TOOL
FEASIBILITY STUDY
(5-32559)

Final Technical Report for Period
10 January 1991 through 30 September 1991

September 1991

Prepared by

Gary A. Maddux
James Clark
Harry Delugach
Charles Hammons
Julie Logan
Anna Provancha

Research Institute
The University of Alabama in Huntsville
Huntsville, Alabama 35899

Prepared for

George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812
Attn: JA81 (Mr. David Jex)

NASA
National Aeronautical and Space Agency

Report Document Page

1. Report No. Final Technical	2. Government Accession No.	3. Recipient's Catalog No.

4. Titile and Subtitle

Automated Payload Experiment Tool Feasibility Study

5. Report Due

September 1991

6. Performing Organization Code

Research Institute, UAH

7. Aurthor(s)

Maddux, Clark Delugach, Hammons, Logan, Provancha

8. Performing Organization Report No.

5-32559

10. Work Unit No.

9. Performing Organization Name and Address

UAH Research Institute
RI E-47
Huntsville, AL 35899

11. Contract or Grant No.

NAS8-36955, D.O. 108

13. Type of report and Period covered

Final Technical Report

12. Sponsoring Agency Name and Address

National Aeronautics and Space Administration
Washington, D.C. 20546-001
Marshall Space Flight Center, AL 35812

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

To achieve an environment less dependent on the flow of paper, automated techniques of data storage and retrieval must be utilized. The prototype under development seeks to demonstrate the ability of a knowledge-based, hypertext computer system. This prototype is concerned with the logical links between two primary NASA support documents, the Science Requirements Document (SRD) and the Engineering Requirements Document (ERD). Once developed, the final system should have the ability to guide a Principal Investigator through the documentation process in a more timely and efficient manner, while supplying more accurate information to the NASA payload developer.

17. Key Words (Suggested by Author(s))

Knowledge-based, Hypertext, Science Requirements Document, Engineering Requirements Document

18. Distribution Statement

19. Security Class. (of this report)	20. Security Class. (of this page)	21. No. of pages	22. Price
Unclassified	Unclassified	7 + Appendix	

NASA FORM 1626 OCT 86

PREFACE

This technical report was prepared by the staff of the Research Institute, The University of Alabama in Huntsville. The purpose of this report is to provide documentation of the work performed and results obtained under delivery order 108 of Marshall Space Flight Center (MSFC) Contract No. NAS8-36955. Mr. Gary Maddux was Principal Investigator for this nine month level of effort. Mr. David Jex of the Microgravity Experiment Projects Office provided technical coordination.

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official NASA position, policy, or decision unless so designated by other official documentation.

I have reviewed this report, dated _9-27-91_ and the report contains no classified information.

Gary C. Maddux
Principal Investigator

Approval:

Charles Hermann
Research Institute

i

TABLE OF CONTENTS

APPENDICES

A   System Flowcharts
B   User Requirements Guide
C   SRD / ERD Cross Reference
D   Prototype Software Listing

1.0 INTRODUCTION

The Quality Improvement Techniques Laboratory at the Research Institute, the University of Alabama in Huntsville (UAH), was tasked by the Microgravity Experiment Projects (MEP) Office of the Payload Projects Office (PPO) to conduct research in the current methods of written documentation control and retrieval. The goals of this research were to determine the logical interrelationships within selected NASA documentation, and to develop a prototype system to demonstrate the capabilities of an electronic knowledge-based system. This prototype was to be used to represent the essence of a computer software application that could provide a "paperless" interface between the prospective principal investigator (PI) and the payload element developer (PED).

2.0 BACKGROUND AND OBJECTIVES

The MEP Office of the PPO at the Marshall Space Flight Center (MSFC) is currently responsible for collecting and coordinating space vehicle/payload specifications and requirements among NASA engineers and various colleges, universities, research centers, and other public- and private-sector organizations that are selected or are requesting to fly their respective experiments on NASA flights. This coordination involves the communication of flight hardware requirements, and the preparation and review of all documentation flowing between NASA and the research groups.

In order to maximize efforts in the coordination of activities between NASA and these research groups, it is necessary to reduce the administrative difficulty encountered by these prospective customers of NASA. To achieve this end, activities must be undertaken to research, analyze, and evaluate the current procedures involved in the design, development and information gathering activities. The objective of this task was to perform a detailed investigation and analysis of the current flight hardware development process, with particular emphasis on the documentation requirements of the project. One element of the system analysis process was the design and development of a demonstrational prototype to aid in the identification and comprehension of the complexities of the data gathering and organizing processes currently involved at MSFC.

3.0 CURRENT ENVIRONMENT

The current environment of manual data gathering and information dissemination is excessively reliant on paper as the primary medium of transfer. This reliance on a static media adds

exponentially to the complexity of a process that by its nature is elaborate. Changes to a document stored on an information media that requires physical manipulation are costly and burdensome. With no method in place to ensure that changes are incorporated throughout follow-on documents, (other than manual verification), modifications to science, engineering, safety, and other documents are more susceptible to human error than necessary.

The design, development and preparation of an experiment to fly in space are time consuming tasks demanding a great deal of technical and disciplinary knowledge. Reducing the time required to prepare an experiment and its supporting documentation is of vital interest to Microgravity Science Applications Division (MSAD). Methods of developing and utilizing state of the art information technologies are of prime concern in simplifying the all-important Principal Investigator (PI)/Payload Element Developer (PED) interface.

4.0 ACTIVITIES

No system should be automated nor modified before it is well understood; therefore, the first concern of this task was the performance of a detailed system analysis. This was accomplished through the evaluation of a number of documents and system flow-charts detailing the documentation preparation processes, and through a number of interviews conducted with MSAD personnel.

The system analysis performed also included, but was not limited to, the evaluation of commercially available software packages and hardware that could be used in the area of payload development planning. These technologies include knowledge-based systems, database management systems (DBMS), fourth generation languages (4GLs), and electronic data interchange, among others. The research and analysis of these technologies, along with the current environment and procedures, was performed in several support actions.

4.1 Form and Documentation Evaluation

UAH collected, analyzed, organized, and evaluated a number of forms and documents used in the current flight hardware develop-ment process. Documents were analyzed as to their content, and also evaluated regarding their relationships both within the same document and within other documents. The findings of this re-search were incorporated in the preliminary design of the proto-type and its accompanying knowledge base.

4.2 Existing Hardware, Software, and Network Evaluation

UAH studied and evaluated currently existing hardware, soft-

ware, and networking capabilities at NASA, along with proposed configurations of the hardware/software interfaces. Several configurations of personal computers were tested to determine the minimum requirements for any future system. These included, but were not limited to, 8088-, 80-286-, and 80-386-based machines. Software was also evaluated to determine the appropriate software platform for development and distribution. These included, but were not limited to, Knowledge Pro, Windows, MS-DOS 3.2, MS-DOS 4.0, MS-DOS 5.0, Read/Write Scanning Systems, and several word processors and support utilities.

4.3 Future Communications, Software, and Hardware Evaluation

UAH performed a detailed investigation and analysis of current commercially available communications, software, and hardware technologies, and made recommendations as to their applicability to MEP, PPO, and NASA activities. This research and evaluation included both current and future products that would effect the performance of the target system. This included operating systems and other support software, communications packages, and hardware products.

4.4 Prototype Development

UAH developed a working prototype of a software system that encompasses the processing logic requirements involved in the collection and dissemination of information between MEP and the researchers. A detailed description of this prototype is presented in Section 7.0.

5.0 PROPOSED SOLUTION

In order to meet the ever increasing demands placed on the PI and the PED, an electronic means of receiving, storing, updating, and transmitting data and information is needed. A product of this task was the conceptual design and development of a proposed solution to this problem. It was understood that this solution must meet the existing needs of MSAD and other MSFC offices, yet be expandable to accommodate future growth and modification. A scaled-down version of this proposed solution is illustrated in Appendix A.

The reliance on a paper driven system dictates that procedures are unnecessarily slow and error-prone. To provide immediate retrieval of support documentation, electronic storage is required. That storage media used must be readily available to a significant majority of the PIs and their staffs. Therefore, the decision was made that the Automated Payload Experiment Tool (APET) software should run on IBM-compatible personal computers (PCs), with minimal restrictions regarding operating systems, primary memory size, secondary storage size, etc.

3

The proposed solution provides an intelligent interface between the PI, the PED, and other supporting offices or organizations. To achieve this intelligence, a knowledge-based technology was selected to allow the creation of rules, along with the mass storage of voluminous documentation. The capture of documentation was and is to be achieved through scanning devices, which will permit direct storage of hardcopy booklets, documents, etc. With a minimal amount of formatting, this knowledge can then be stored in a machine readable form.

Two rules which were of overriding concern were to make the system easy to use and easy to learn. Since the proposed system will be highly domain specific, its only use will be the preparation of NASA documents. Thus, the system must be one that can be learned with a minimum of training, with the user largely self taught. This can be partially achieved by making the system intuitive to the novice user, i.e., prompts will be free of technical jargon, navigation through the system will be logical, and on-line help will be context sensitive.

Once system and support documentation has been captured and coded in the necessary format, the system should be easily transportable to the user. The primary means of transfer will be via floppy disk (3 1/2 or 5 1/4 inch). Once received and installed at the PI site, he/she will respond to a structured listing of prompts while being guided to document completion. The PI should be able to generate hardcopy reports, if desired, and submit data (completed documentation) on diskette to MSAD when finished. From these diskettes, the PED or other involved entities can ascertain inconsistencies, irregularities, or other anomalies, and can resolve these with the PI in a timely manner. The recipient of the documentation will also have the capability to generate hardcopy documents as circumstances dictate.

6.0   CONCEPTUAL DESIGN

Based on the research and system analysis performed, the conceptual design of the proposed system was formulated. Several characteristics were determined essential to its success. Among these were:

o **Modularity** -- The structure of the system, as with any well-constructed software, should be modular. By designing the software system in structured routines, the problems of internal memory constraints are greatly reduced. The system can be fully functional, giving full on-line support for definitions, acronyms, document descriptions and explanations, help messages, etc. As the software system grows to include more on-line reference material, the modularity of the software will be fundamental to

its success.

o **Expandability** -- While the original thrust of this task emphasized only two NASA documents, it is understood that the scope of this project could and should include many others. To ensure the optimal success of the system, it must be designed to accommodate the addition of other support documents without adversely effecting previously implemented components of the system.

o **Utilization of hypertext** -- To provide the quick retrieval of key words, phrases, or document subsections, the use of a hypertext technology is necessary. Thus, to ensure both ease of use and ease of development, the eventual system should employ the hypertext technology. This was a foremost consideration in the choice of the prototype development software.

o **Utilization of a simple user interface** -- Based on the research conducted, and the comments of the MSAD technical staff, the parties involved in this research activity agreed that the end user must be able to learn to use the system with little or no formal training. Therefore, the use of a point-and-click type device (a mouse) should be supported by the proposed system.

7.0   PROTOTYPE DEVELOPMENT

To fully determine the needs and requirements of future system users, a prototype was developed to demonstrate the development team's understanding of the system. This prototype, known as the APET, was used as a tool in the system analysis activity, and was used in several meetings to elicit information from MSAD personnel. To keep the prototype to a manageable size, it was jointly decided that APET would initially address two documents: the Science Requirements Document (SRD) and the Engineering Requirements Document (ERD).

The first decision in the prototype development was the selection of a supporting language. The criteria for selecting this language was two-fold. First, it had to meet the specifications of the proposed system, i.e., hypertext and knowledge-based. Second, it had to be a language that was easy to use and maintain. The best match of these two criteria was Knowledge Pro, a commercially available product of Knowledge Garden Inc., Nassau, New York.

With the software development package selected, the conceptual system was developed into a preliminary design. With each iteration of its development, the prototype more clearly defined what was needed from the final system. This information was used to create the User Requirements Guide (See Appendix B), which is a dynamic document that contains current specifications

of the system.

The initial prototype of the software was used to demonstrate the hypertext capability of the system. As these concepts of on-line support documentation and document structure were implemented, the task of designing the logical relationships (See Appendix C) between documents became the primary area of concern. There are essentially two relationships to be explored: 1) a logical relationship within the same document and 2) a logical relationship between two different documents. This was accomplished by evaluating the SRD and the ERD cross-references and choosing relationships that met one or both of the relationships.

Knowledge Pro is the recommended language for the development and implementation of the full-scale APET system. It meets or exceeds the capabilities sought in the initial specifications, and can be easily modified and maintained. The language facilitates a structured software development approach, and can be used to implement additional enhancements. The development language uses English-like commands and phrases, which also aids the design process. A listing of APET source code is included in Appendix D.

8.0 CONCLUSIONS AND RECOMMENDATIONS

To alleviate the burden of excessive manually generated documentation research and preparation, we are recommending that the Microgravity Science Applications Division pursue further development of the Automated Payload Experiment Tool into a finished, executable software system.

MSAD is concerned with the ease with which a principal investigator or potential principal investigator can complete his/her documentation requirements. To meet those requirements as they currently exist, the procedure for their preparation must be understood. The initial efforts of this task were primarily concerned with the comprehension of the complexities of the current system. This knowledge can now be used to make informed decisions concerning ways to improve the process. With a thorough understanding of the process, a system can be constructed to address the quality issues of the information generated, i.e., timeliness, completeness, integrity, etc., rather than the quantity of information.

It is the goal of APET to deliver to the PED, PI, or any party with a need to know, the information needed to effectively and efficiently prepare an experiment for space flight. To achieve this goal, state-of-the-art technology must be used to allow the system users to work smarter, to produce more with less, and to deliver to their customers a defect-free product. These products, in the form of engineering specifications, func-

tional objectives, astronaut training requirements, etc., permit the preparation and execution of experiments to be dependent on the technical rather than the clerical abilities of the PI.

EXHIBIT A

System Flowcharts

Envisioned System Operations

Principal Investigator
Interface

SRD | ERD
Printed
Documents

System &
Support
Documentation

Completed
Documentation

Phase I

After completion of this
phase, this section will be
used for documentation
control.

Scanned
documents

NASA
Interface

SRD
ERD
Printed
Documents
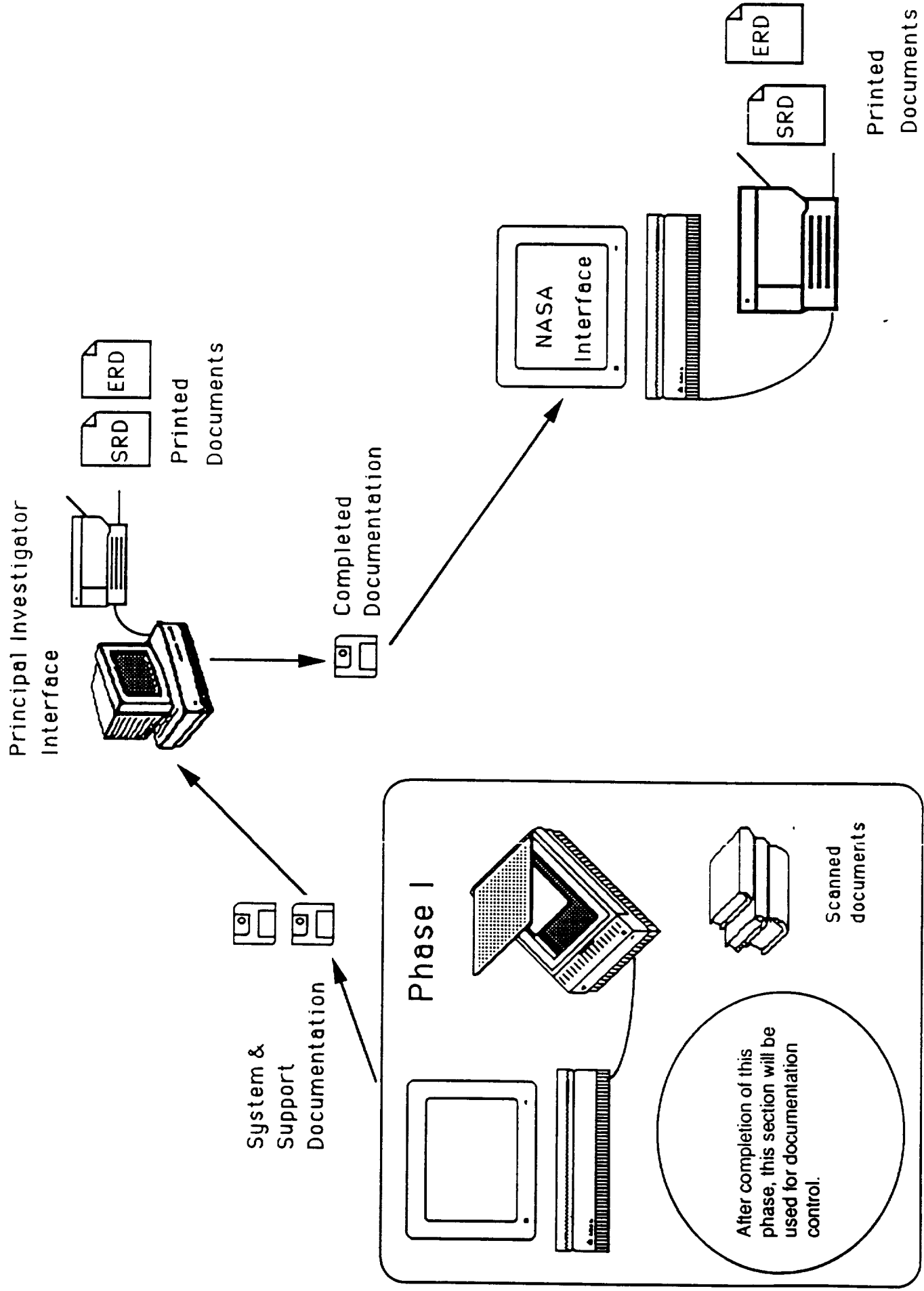
EXHIBIT B

User Requirements Guide

REQUIREMENTS FOR

AN AUTOMATED PAYLOAD EXPERIMENT TOOL

August 1991

Prepared by

Gary A. Maddux
James Clark
Harry S. Delugach
Charles Hammons
Julie Logan
Anna Provancha

Research Institute
The University of Alabama in Huntsville
Huntsville, AL 35899

Prepared for
George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812

REQUIREMENTS FOR

AN AUTOMATED PAYLOAD EXPERIMENT TOOL

August 1991

Executive Summary

This document describes the requirements for an Automated Payload Experiment Tool to assist the National Aeronautics and Space Administration (NASA) Marshall Space Flight Center (MSFC) in managing the information, planning and paperwork involved in flying experiments on the Space Transportation System.

Section 1 of this document describes its purpose and scope.

Section 2 describes the general features of the required tool. It explains the general function of the tool, who will use it, what is expected during its intended lifecycle, and any fundamental assumptions underlying its purpose.

Section 3 gives the functional requirements, providing details of its expected capabilities.

Section 4 describes the interfaces between the tool and other hardware, software and organizations.

Section 5 lists constraints on the performance of the tool, such as response time and operating limits.

Section 6 addresses the level of quality required of the software.

Section 7 includes some miscellaneous requirements and the anticipated lifecycle of the software.

Acronyms and Definitions are listed at the end of the document.

TABLE OF CONTENTS

Topic   Page

1.0 INTRODUCTION

This document describes the requirements for an Automated Payload Experiment Tool (APET) to assist the National Aeronautics and Space Administration (NASA) Marshall Space Flight Center (MSFC) in managing the information, planning and paperwork involved in flying experiments on the Space Transportation System (STS). The tool's goals are to enhance communication between principal investigators, payload projects offices, mission managers and builders of experiment hardware, eliminate information duplication and ease modifications to experiment paperwork.

With the number of ongoing projects and the experiments planned for the future, the demand for increased coordination and dissemination of information becomes apparent. In order to maintain the volumes of documentation and written communications with which MSAD and its PIs are tasked, more timely and efficient techniques must be developed.

One method of improving the documentation management process is to combine the file storage capabilities of an electronic database and the intelligence of an expert knowledge base. By integrating these two concepts, an automated system can be provided that will store, manage, and retrieve relevant data entries, while providing the guidance needed to meet the documentation requirements completely and succinctly.

APET will provide an environment whereby a principal investigator (PI) who wishes to fly an experiment aboard the STS may interactively supply the user data needed to satisfy NASA's management and reporting responsibilities. The PI will have easy access to all NASA information that applies to the particular document section being filled out.

1.1. Purpose

This software requirements specification is intended for several groups currently involved in the APET's development. These include, but are not limited to:

o Personnel in the Microgravity Science and Applications Division (MSAD) who are responsible for managing microgravity experiments to fly on the STS.

o Personnel in the other divisions who are responsible for managing experiments to fly on the STS.

o Personnel who will design software for the payload experiment tool being developed.

o Principal investigators (PI's) proposing experiments to be flown on the STS.

1.2. Scope

This document defines the APET. It outlines the organizational, managerial and technical needs to be met by the system. It is intended to be used as a reference document that will be consulted and updated as necessary throughout the development of the software.

In this document the words **shall** or **will** mean that the software must fulfill the requirements as stated. The word **should** means that the requirement is desired, but not essential to the system's primary goals. The word **may** means that the requirement refers to contingencies or future development.

1.3. References

MSAD Management Plan

JA-003 - General Guidelines and Requirements for MSFC-developed Spacelab/STS Experiments

JA-1303 - Guidelines and Requirements for MSFC-developed Attached Payload Experiments for Space Station Freedom

2

2.0 GENERAL DESCRIPTION

2.1 Product Perspective

APET will operate on general purpose personal computers that are readily available to PI's and MSAD. It is not intended to involve significant purchases on the part of the PI, although some additional expense may be involved.

The APET software will be delivered to the PI who will supply general and specific user data, as appropriate, through interaction with APET. The resulting data will be forwarded to MSAD for evaluation, printing of relevant forms, and further clarification.

2.2. Product Functions

The general functions of APET include, but are not limited to:

o Provide access to SRD information and user data entry for the PI.

o Provide access to ERD information and user data entry for the PI.

o Provide cross references between the SRD and the ERD.

o Identify the documents and forms appropriate for each PI.

o Provide appropriate and consistent interface for PI's data entry.

o Produce NASA reports/forms as necessary.

2.3. User Characteristics

APET's primary users are PIs whose expertise in the use of computers or computer interfaces may vary. Since APET is intended for frequent use over a relatively short period of time, users are not expected to memorize details of its operation.

2.4. General Constraints and Assumptions

The PI will have access to a personal computer with a hard disk drive and printer.

The time involved in interaction with APET should be minimized for the PI's benefit, although supplying data for different experiments will necessarily take up varying amounts of time.

APET is intended to be self-contained, so that minimal involvement is required between the PI and MSAD personnel. The PI's use of hardcopy manuals should be minimized.

Although most PI's will use the system for only one experiment, APET must accommodate more than one experiment's data (e.g., via a user-specified project name/number). In those cases, unique experiment data must be clearly separated.

The ERD will be used by the hardware builder to fabricate whatever materials are needed to perform the experiment.

3.0 FUNCTIONAL REQUIREMENTS

In order to meet the above conceptual design, a prototype was developed to demonstrate the preliminary capabilities of the proposed system. The tentative system, known as the Automated Payload Experiment Tool (APET), was constructed to help identify the needs and requirements of the user community. Through iterative sessions with MSAD personnel, the following criteria were determined essential in the finished system:

    o   The APET system should utilize an expert system methodology that allows the instructions required for the completion of the documentation task to be built into the software. This feature requires an intensive examination of the current documentation process, the logical interrela-

tionships between the required documents, and the functional objectives of each document. These documents include the Science Requirements Document, the Engineering Requirements Document, technical briefs, safety reports, and others.

o   To minimize the future maintenance activities required, the logical linkages between documents should be clearly illustrated. This should also be accomplished in an easily retrievable form.

o   The system should utilize a "point and click" user interface to minimize user resistance and user difficulty. The primary user interface should be a standard keyboard (for entry of textual data) and a mouse (for system navigation and information retrieval).

o   The system should minimize the use of paper documents, either as support documentation or as output. However, the need for report generation using paper media is recognized as a necessary output of the system. Therefore, users should be provided the opportunity to print reports as needed, either in whole or in part.

o The system should provide an on-line user tutorial to quickly guide the inexperienced user in its operation. This tutorial should provide an overview of the commands necessary for basic operation of the user system.

o   The system should explain to the user what information is required and what reporting requirement necessitates its completion.

o   The system, in as much as possible, should provide support (NASA supplied) documentation in electronic form on an as needed basis. This requirement can best be handled through a hypertext technology, utilizing a point and click interface. Hypertext will provide the user immediate

retrieval of support documents, definitions, and/or background information in the most timely manner.

o   The system should support multiple experiments (projects). The system should ensure that these experiments are treated as distinct entities, yet provide easy access to all.

o   The system should be easily maintainable and expandable. Enhancements and modifications to the software should be easily changed to accommodate different reporting and data requirements.

o   The construction of the software should be modular, with minimal interdependence between software modules.

o   The system should require little added monetary expense of the end user. The system should run on an IBM personal computer or compatible. The specific computer configuration requirements required for the final system should be minimized; however, due to the preliminary stage of system development, these specifications have yet to be determined.

The result of the APET finished project is not the software tool, but the improved efficiency and timeliness of the information generated by the tool. The improvements in the quality of the documentation should result in, but not be limited to:

o   Improved communications' capability between and among all affected people and organizations.

o   User-controlled processing. Menu choices will be used to provide the users with a versatile means of inputting data and obtaining information.

o   Ability to consolidate data and standardize processing for efficient update and throughput.

o   On-line features to alert the users as to invalid or erroneous data.

o   A "follow-me" guide for the user that will simplify the creation of documentation preceding and accompanying scientific experiments.

o   Control functions to permit adding, modifying, deleting, and displaying of data.

o   Information retrieval capability to provide reports related to conducting scientific experiments in micro-gravity environments.

o   Document generation, which will be addressed by identifying reports that are required and the scheduling of their execution.

o   Modular design concepts for easier software maintenance and modification considerations.

o   Flexibility for satisfying future needs, both planned and unplanned.

o   Identification/maintenance of logical relationships between and among documents.

o   Process simplification and decreased/reduced data redundancy.

o   Reduced dependency on paper media as the primary communications media.

4.0 EXTERNAL INTERFACE REQUIREMENTS

4.1. User Interfaces

The user interface will be tailored to the needs and skill level of a typical PI, with training provided by hard-copy manuals or through the use of on-line help.

The user interface will provide a consistent environment to the PI. Prompts will be standardized, with operating modes such as the use of function keys, help keys and text-editing similar among different features.

The PI will be able to choose between several document sections to work on as he/she desires, while the APET guides him/her through the required documents. The PI will be able to skip a request for data and return to it in a later session.

The user will be informed as to the current status, e.g., what sections have been done and what sections remain to be done.

4.2. Hardware Interfaces

The software will operate on an IBM PC-compatible computer, with a minimum of 640K RAM (1 Megabyte is preferred) and permanent storage (e.g, a hard disk drive) of at least 20MB capacity.

4.3. Software Interfaces

APET will operate under current versions of MS-DOS (3.1, 4.0 and 5.0), with version 5.0 preferred.

4.4. Communication Interfaces

In the future APET may be required to upload PI user data over an asynchronous telephone link via a modem to a NASA host.

5.0 PERFORMANCE REQUIREMENTS

5.1. Response and Processing Time

Response time of the system will vary depending upon the particular model and configuration of the PC used.

5.2. Storage Limitations.

APET software may make use of several megabytes of disk space. Since the

system is intended to be extendible and expandable, ample disk space should be provided for storing additional information.

6.0 ATTRIBUTES

6.1. Security

All information and user data contained within the APET are publicly available, so no special security considerations are anticipated. The APET software itself will be write-protected; any alterations to its information will be performed at NASA's project offices. User data will be stored separately from the APET software, and be modifiable by the PI.

6.2. Reliability

The system must be robust enough to preserve the PI's user data during each interactive session. Between sessions, the PI is encouraged to make a backup copy of user data on either a floppy or hard disk. An option may be provided for compressing data when storing on a floppy disk, and decompressing the data when it is retrieved.

6.3. Maintainability/Extendibility

The system will be structured to permit modification to accommodate changes to NASA or MSAD procedures and manuals. When such a change is performed, a PI's existing data may have to be verified again, possibly requiring additional user data or explicit changes from the PI.

The system can be extended to accommodate additional manuals (e.g., safety documents, mission manager guidelines, etc.) and additional divisions. Formal procedures will be established to make and verify changes in a systematic way.

7.0 OTHER REQUIREMENTS

7.1. Data Base

It is expected that the data base required will continually increase in size as more documents are added to APET. There are several alternatives for the storage medium: hard disks, network access to a mainframe, optical disks or removable disk drives. Evaluation of these alternatives will depend on their cost, and the estimated size of the eventual full-scale product.

Data gathered from the PI may be accessible to other applications, such as word processors, spread-sheets or information services.

7.2. Operations/Delivery

The APET software will be delivered to the PI in machine-readable form.

PI's should make frequent backups of their data, just as for any other important data. The APET software may automate some of that process.

The PI must install the APET software on his/her hard disk before interacting with the software.

8.0 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

APET - the Automated Payload Experiment Tool software product.

Document - source information for describing the user data that a PI must supply and in what form(s).

ERD - Experiment Requirements Document. In some divisions called an Engineering Requirements Document. A general description of the engineering design required to build the experiment.

Experiment - a scientific investigative activity involving some materials or procedures as part of a STS mission.

Form - A prescribed collection of particular user data items, as prescribed in documents or the management plan.

Information - contents of any manuals, outlines, or guidelines explaining what forms are required, or what user data the PI needs to supply. Some information is in graphical form.

MB - Megabytes; units of 1024K 8-bit bytes of electronic data storage.

MROFIE - NASA document entitled Mission Requirements On Facilities, Instrumentation and Experiments. The standard reference for any STS mission for which MSFC is responsible.

MSAD - the Microgravity Science and Applications Division of NASA's Marshall Space Flight Center

MS-DOS - an operating system developed by Microsoft for personal computers.

MSFC - Marshall Space Flight Center, Huntsville, Alabama.

MS Windows 3.0 - a windowed, menu-driven mouse-operated environment developed by Microsoft that provides a standard interface to programs on personal computers.

PC - personal computer; an IBM-PC compatible computer.

PI - principal investigator running an STS experiment; the experimenter.

RAM - random access memory; also called "main storage" or "core memory".

STS - the Space Transportation System.

SRD - Science Requirements Document - a general description of the science goals of an experiment, and the procedures to be followed in carrying out the experiment.

User Data - any experiment-specific facts or text supplied by the PI.

EXHIBIT C

SRD / ERD Cross Reference

LINKS BETWEEN THE ERD and the SRD

1 Function Objectives & Equipment Identification
    1.1 Functional Objectives
    This section is referenced further in:
    ERD Sections
        11.1 PED/PI Defined Training
        11.2 PMM and PED/PI Jointly Defined Training
    SRD Sections
        4.0 Experiment Details
        5.0 Experiment Requirements

    1.2 Equipment Identification
    This section is referenced further in:
    SRD Section
        6.2 Apparatus Design Assistance

    1.3 Operational Function Flows
----

2 Structural/Mechanical
    This section is referenced further in:
    SRD Section
        6.2 Apparatus Design Assistance
----

3 Pointing/Stabilization and Alignment
    SRD Section
        5.6 Imaging Requirements

    3.1 Requirements Description

    3.2 Pointing/Stabilization and Field-Of-View Requirements
        3.2.1 Pointing Requirements

        3.2.2 Stability Requirements
        This section is referenced further in:
        SRD Sections
            5.4 Vibration Control and Measurement

        3.2.3 Field-of-View Requirements

        3.2.4 IPS Pointing Requirements

    3.3 Experiment Pointing and FOV Capabilities

    3.4 Experiment On-Orbit Acceleration and Vibration Limits
        This section is referenced further in:
        SRD Section
            5.4 Vibration Control and Measurements

    3.5 Experiment Alignment and Coalignment Requirements

4 Orbital Requirements and Constraints
    Desired Orbit Characteristics
    Earth and Celestial Target
    Viewing Requirements and Constraints
    Vehicle Motion and G-Level Limits

    This section is referenced further in:
    SRD Sections
        5.1 Experiment Sample Requirements
        5.5 Test Matrix
        5.6 Imaging Requirements
----

5 Electrical Requirements
    This section is referenced further in:
    SRD Sections
        5.1 Experiment Sample Requirements
        5.6 Imaging Requirements
        5.7 Electromagnetic Limitations
----

6 Thermal Control/Fluid Requirements
    6.1 Heat Transfer Characteristics
        Module Equipment On-Orbit Thermal Requirements
        Pallet/Airlock Equipment On-Orbit Thermal Requirements

    This section is referenced further in:
    SRD Section
        5.3 Temperture Control and Measurement

    6.2 Fluid Requirements
    This section is referenced further in:
    SRD Sections
        5.2 Atmospheric Requirements
        6.2 Apparatus Design Assistance

    6.3 Ascent/Decent Thermal Control Requirements
        Module Equipment On-Orbit Thermal Requirements
        Pallet/Airlock Equipment On-Orbit Thermal Requirements
        Fluid Requirements

    This section is referenced further in:
    SRD Sections
        5.2 Atmospheric Requirements
        5.3 Temperature Control and Measurement

2

7 Data System Requirements

7.1 Payload Element to CDMS Interfaces Tables
Signal Interface Definition
Display Requirements
Event/Exception Monitor Requirements
Direct HRM, Analog, Video and MTU Requirements
Processed Dedicated HRM Channel Parameter Definition
POCC Display Requirements
POCC Limit Sensing/Exception Monitor Requirements

This section is referenced further in:
ERD Sections
    10.0 Mission Operations Support
    11.3 PMM Defined Training
    11.5 Training Participation
SRD Sections
    5.5 Test Matrix
    5.6 Imaging Requirements
    5.9 Data Requirements
    6.5 Services

7.2 Caution and Warning
Signal Interface Definition

7.3 Error Messages Documentation
Error Message Information Input

---

8 Flight Software Requirements

8.1 Summary of Experiment Computer Software Requirements
This section is referenced further in:
SRD Sections
    5.9 Data Requirements
    6.5 Services

---

9 Physical Integration

9.1 Ground Integration Processing Flow and Definitions

9.1.1 Experiment/ Facility Preintegration
This section is referenced further in:
SRD Section
    4.5 Preflight Experiment Planned
    6.1 Research Equipment

9.1.2 Experiment Integration

9.1.3 Payload Integration

9.1.4 Experiment Deintegration
This section is referenced further in:
SRD Sections
    4.6 Post Flight Data Handling and Analysis
    6.1 Research Equipment

9.2 Experiment/Facility Developer Requirements Definition
  9.2.1 Experiment/Facility Preintegration
  This section is referenced further in:
  SRD Section
    4.5 Preflight Experiment Planned

  9.2.2 Experiment/Facility Preparation
  This section is referenced further in:
  SRD Sections
    4.1 Experiment Details
    4.3 Test Plan Including Ground Char. of Flight Hardware
    6.2 Apparatus Design Assistance

  9.2.3 Experiment User Room Requirements

  9.2.4 Experiment Late-Access Design Requirements
  This section is referenced further in:
  SRD Sections
    4.6 Post Flight Data Handling and Analysis
    6.1 Research Equipment

  9.2.5 Postmission Requirements
  This section is referenced further in:
  SRD Sections
    4.6 Post Flight Data Handling and Analysis
    6.1 Research Equipment

  9.2.6 Postmission Early-Access Requirements
  This section is referenced further in:
  SRD Sections
    4.6 Post Flight Data Handling and Analysis
    6.1 Research Equipment

  Solids, Fluids, and Gases Resource Requirements
  ----

10 Mission Operations Support
  This section is referenced further in:
  ERD Sections
    7.1 Data System Requirements
    11.3 PMM Defined Training
  SRD Section
    5.9 Data Requirements

  10.1 POCC Requirements
  10.1.1 POCC Processing

  10.1.2 EGSE

  10.1.3 Workstation

  10.1.4 Remote Interfaces

The Links between the SRD and the ERD

1 Introduction/Summary
    1.1 Description of experiment
       This section is referenced further in:
  SRD Sections
       4.0 Experiment Details
       5.0 Experiment Requirements
  MSAD Management Plan
       E.2.5.1 Missions
       E.2.5.2 System(s) and Subsystems
  JA-003
       2.1 General (Flight Equipment Design and Fabrication)
  JA-1303
       2.1 General (Flight Equipment Design and Fabrication)

    1.2 Scientific Knowledge to be Gained
       This section is referenced further in:
  SRD Section
       2.6 Anticipated Advance in the State of the Art

    1.3 Value of Knowledge to Scientific Field
       This section is not referenced further.

    1.4 Justification of the Need for Space Environment
       This section is referenced further in:
  SRD Section
       3.0 Justification for Conducting the Experiment in Space
  ----
2 Background
    2.1 Description of Scientific Field to Which the Experiment Belongs
       This section is not referenced further.

    2.2 Current Application for Research in the Field
       This section is not referenced further.

    2.3 Brief Historical Account Prior Research
       This section is referenced further in:
  ERD Section
       11.1 PED/PI Defined Training
       (Science Background and Experiment Objectives)

    2.4 Current Research
       This section is referenced further in:
  MSAD Management Plan
       E.2.4 Related Studies and Activities

    2.5 Relationship of Proposed Environment to Scientific Field
       This section is not referenced further.

    2.6 Anticipated Advance in the State of the Art
       This section is referenced further in:

SRD Sections
        1.2 Scientific Knowledge to be Gained
        4.8 Application of Results
3 Justification for Conducting the Experiment in Space
        This section is referenced further in:
        SRD section
            1.4 Justification of the need for space environment

    3.1 Limitations of Ground-Based Testing
        This section is not referenced further.

    3.2 Limitations of Drop Towers
        This section is not referenced further.

    3.3 Limitations of Testing in Aircraft
        This section is not referenced further.

    3.4 Need for Accommodations in the Shuttle
        This section is not referenced further.

    3.5 Limitations of Mathematical Modeling
        This section is not referenced further.

    3.6 Limitations of Other Modeling Approaches
        This section is not referenced further.
----
4 Experiment Details
        This section is referenced further in:
        SRD Section
            1.1 Description of Experiment
        ERD Section
            1.1 Functional Objectives

    4.1 Experiment Procedures to be Used
        This section is referenced further in:
        SRD Sections
            5.1 Experiment Sample Requirements
            5.5 Test Matrix
        ERD Section
            9.2.2 Experiment/Facility Preparation

    4.2 Measurements Required
        This section is referenced further in:
        SRD Sections
            5.1 Experiment Sample Requirements
            5.2 Atmospheric Requirements
            5.3 Temperature Control and Measurement
            5.4 Vibration Control and Measurement

4.3 Test Plan Including Ground Characterization of Flight Hardware
    This section is referenced further in:
MSAD Management Plan
    E.2.5.4 Flight Hardware Classification
JA-003
    2.1 General (Flight Equipment Design and Fabrication)
JA-1303
    2.1 General (Flight Equipment Design and Fabrication)

4.4 Specific Analysis Required
    This section is referenced further in:
SRD Section
    5.1 Experiment Sample Requirements

4.5 Preflight Experiment Planned
    This section is referenced further in:
SRD Sections
    6.1 Research Equipment
ERD Sections
    9.1.1 Experiment/Facility Preintegration
        (Ground Intergration)
    9.2.1 Experiment/Facility Preintegration
        (Developer Requirements)
JA-003
    6.1.2.3 Payload Integrated Testing
JA-1303
    8.1 Payload Prelaunch Handling

4.6 Post Flight Data Handling and Analysis
    This section is referenced further in:
SRD Section
    6.1 Research Equipment
ERD Sections
    9.2.4 Experiment Late-Access Design Requirements
    9.2.5 Postmission Requirements
    9.2.6 Postmission Early-Access Requirements
MSAD Management Plan
    E.2.5.8 Analysis of Mission Results
JA-003
    9.1 Post-Flight Data Reduction, Analysis, and Reporting
JA-1303
    9.1 Post-Flight Data Reductioin, Analysis, and Reporting

4.7 Mathematical Models Used
    This section is not referenced further.

4.8 Application of Results
    This section is referenced further in:
SRD Sections
    1.2 Scientific Knowledge to be Gained
    2.6 Anticipated Advance in the State of the Art

5 Experiment Requirements

This section is referenced further in:
SRD Section
   1.1 Description of Experiment
ERD Section
   1.1 Functional Objectives

5.1 Experiment Sample Requirements

This section is referenced further in:
SRD Sections
   4.1 Experiment Procedures to be Used
   4.2 Measurements Required
   4.4 Specific Analysis Required
ERD Sections
   4.0 Orbital Requirements and Constraints
   5.0 Electrical Requirements

5.2 Atmospheric Requirements

   Pressure   Gas Composition
   Humidity   Vacuum

This section is referenced further in:
SRD Section
   4.2 Measurements Required
ERD Sections
   6.2 Fluid Requirements
   6.3 Ascent/Decent Thermal Control Requirements
   12.1 Flight Environmental Limits

5.3 Temperature Control and Measurement

This section is referenced further in:
SRD Section
   4.2 Measurements Required
ERD Sections
   6.1 Heat Transfer Characteristics
   6.3 Ascent/Decent Thermal Control Requirements

5.4 Vibration control and measurement

This section is referenced further in:
SRD Sections
   4.2 Measurements Required
ERD Sections
   3.2.2 Stability Requirements
   3.4 Experiment On-Orbit Acceleration and Vibration Limits

5.5 Test Matrix

This section is referenced further in:
SRD Section
   4.1 Experiment Procedures to be Used
ERD Sections
   4.0 Orbital Requirements and Constraints
   7.0 Data System Requirements

5.6 Imaging Requirements
    Photography   Radiography
    Television   Resolution
    Frame rate

    This section is referenced further in:
SRD Section
    6.5 Services
ERD Sections
    3.0 Pointing/Stabilization and Alignment
    4.0 Orbital Requirements and Constraints
    5.0 Electrical Requirements
    7.0 Data System Requirements

5.7 Electromagnetic Limitations
    This section is referenced further in:
ERD Section
    5.0 Electrical Requirements
JA-003
    2.3.4 Electromagnetic Interference
JA-1303
    2.3.4 Electromagnetic Interference

5.8 Astronaut Involvement
    Extravehicular Activity [EVA]
    Activation of Experiment
This section is referenced further in:
ERD Section
    11.0 Training Objectives

5.9 Data Requirements
    This section is referenced further in:
SRD Section
    6.5 Services
ERD Sections
    7.0 Data System Requirements
    8.0 Flight Software Requirements
    10.0 Mission Operations Support
JA-003
    2.2.2 Data and Analysis
JA-1303
    2.2.3 Data and Analysis

5.10 Telepresence, Telerobotics
    This section is not referenced further.

6 Principal Investigator's Requirements
    6.1 Research Equipment
        Preflight   Postflight
        This section is referenced further in:
    SRD Sections
        4.5 Preflight Experiment Planned
        4.6 Post Flight Data Handling and Analysis
    ERD Sections
        9.0 Physical Integration

    6.2 Apparatus design assistance
        This section is referenced further in:
    ERD sections
        1.2 Equipment Identification
        2.0 Structural/Mechanical
        6.2 Fluid requirements
        9.2.2 Experiment/Facility Preparation

    6.3 Consultation
        This section is not referenced further.

    6.4 Grant, Contract
        This section is not referenced further.

    6.5 Services
        Film Developing
        Software Development
        This section is referenced further in:
    SRD Sections
        5.6 Imaging Requirements
        5.9 Data Requirements
    ERD Sections
        7.0 Data System Requirements
        8.0 Flight Software Requirements
        9.0 Physical Integration
----

7 Other Requirements
  This section is not referenced further.

Last Modifications: August 22, 1991.

EXHIBIT D

Prototype Software Listing

```
(*NASA.KB          This is the prototype for the design of        *
(*                 a knowledge-based system to aid in the         *
(*               development of NASA documentation for            *
(*                  pre-flight planning and control.              *

no_edit_key ().
(* no_debug (). *)
do_gloss = 1.
action = ' '.
nasaloop = 1.


while ?action <> 'Exit System'
  then do (mainmenu).

topic 'mainmenu'.

choices = ['How to use the System','Project Selection',
          'SRD Overview and Explanation','ERD Overview and Explanatio
          'SRD Documentation Cross-Reference',
          'ERD Documentation Cross-Reference','Glossary/Acronyms',
          'Exit System'].

window (,white,red,yellow,5,5,75,16).

  ask ('#e
  Please select the activity of your choice, or choose Exit
  to leave the system.',action,?choices).

close_window ().

if ?action = 'How to use the System'
  then new_kb ('intro.hkb').

if ?action = 'Project Selection'
  then new_kb ('project.hkb').

if ?action = 'ERD Overview and Explanation'
  then new_kb ('erdover.hkb').

if ?action = 'SRD Overview and Explanation'
  then new_kb ('srdover.hkb').

if ?action = 'SRD Documentation Cross-Reference'
  then new_kb ('crossref.hkb').

if ?action = 'ERD Documentation Cross-Reference'
  then new_kb ('erdref.hkb').

if ?action = 'Glossary/Acronyms'
  then do (glossary).

if ?action = 'Exit System'
  then exit ().
```

```
(* **************************************************************** *)
topic glossary.

if ?do_gloss = 1
  then
    window (,white,red,yellow,1,16,27,4)
    and
    WRITE ('con:',
'  A slight delay will
 occur while the
 glossary is loaded.
 Please stand by.              ')
    and
    load ('nasaterm.hkb')
  and
    do_gloss = 2   -
  and
    glossary = QUIT
  and
    glossary_choice = '   '
  and
    glossary gets children(glossary)
  and
    glossary is remove (?glossary,[prototype,hypertext])
  and
    close_window ()
  and
    window ('Glossary of Terms',blue,white,white).

while ?glossary_choice <> QUIT
  then
    ask ('
 Please choose the word or term that you desire to look up.',
  glossary_choice,?glossary)
    and
    if ?glossary_choice <> QUIT
      then
        do (?glossary_choice)
      and
        close_window ().
close_window ().

end. (* glossary *)




end. (* mainmenu *)
```

```
(*INITIAL.KB        This program is used to allow the user          *)
(*                     to enter standard project initialization     *)
(*                     information, i.e. name, address, title, etc.  *)


curdir is read_line ('CURDIR.DAT').
curdir = string_replace(?curdir,' ','',8).


yn is [YES,NO].
chgwant = '   '.

do (personal_info).
new_kb ('fillmenu.hkb').

topic 'personal_info'.

blankline = '.'.
close_window ().
eof = number_to_char (26).

text is read_line (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT')).
if ?text = ?eof
   then do (new_personal)
   else
   oldtext is read (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT'))
   and
   chgwant = '    '
   and
   while ?chgwant <> QUIT
     then do (edit_personal).

(* ================= get new personal information ====================

topic 'new_personal'.
WRITE ('con:','#eIn the window below, please provide some general inform
about yourself and your experiment.                                   ')

window (,white,red,yellow,5,5,75,16).

read_response ('#e
     #fyellow Please enter your first and last names, i.e. Dr. John Doe.
                                                #n ',name,?
                                                blankline).
   name = concat ('NAME:              ',?name).
   personal gets ?name.


read_response ('#e
     #fyellow Please enter the name of your organization.#d
                                       #n ',organization,
                                       ?blankline).

   organization = concat ('ORGANIZATION:     ',?organization).
   personal gets ?organization.
```

```
read_response ('#e
      #fyellow Please enter the mail code, P.O Box, room number, or other
      address information of your organization.#d
                                                  #n',mail_code,?blankline).

   mail_code = concat ('MAIL CODE:          ',?mail_code).
   personal gets ?mail_code.

read_response ('#e
      #fyellow Please enter the street address of your organization.#d
                                            #n',street,
                                            ?blankline).

   street = concat ('STREET:          ',?street).
   personal gets ?street.

read_response ('#e
      #fyellow Please enter the city, state, and zip code of your organiz
      #d                                #n',city_st_zip,
                                            ?blankline).

   city_st_zip = concat ('CITY, STATE, ZIP: ',?city_st_zip).
   personal gets city_st_zip.

read_response ('#e
      #fyellow Please enter your phone number.#d
                                            #n',phone,
                                            ?blankline).

   phone = concat ('PHONE:          ',?phone).
   personal gets ?phone.

say ('#e
   Please enter the title of your experiment in the desired format,
   i.e. centered, justified, etc.

      Press the #fyellow RETURN KEY#d to enter the editor,
      #fyellow ESC#d to leave the editor, and #fyellow RETURN#d to confirm

edit_file (concat (C:\GARDEN\,?CURDIR,'\TITLE.DAT'),yellow,black,red,5,9

author_info is [?name,#n,?organization,#n,?mail_code,#n,?street,#n,
?city_st_zip,#n,?phone,#n].
   new_file (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT')).
   write    (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT'),?author_info,#n).
   close    (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT')).

if ?chgwant <> QUIT
   then
     ask
     ([?author_info, '#n #fyellow
     The information listed above was written to the text file
     AUTHOR.DAT.  Do you wish to change any of these entries?#d'],change_
     60,16)
   and
     if ?change_again = YES
```

2

```
        then
          oldtext is read (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT'))
        and
          change_again = NO
        and
      chgwant = '       '
        and
      while ?chgwant <> QUIT
        then do (edit_personal).


    close_window ().

    WRITE ('con:','#e       ').
    end. (* new_personal *)

    (* =============== get corrected personal information ================

    topic 'edit_personal'.

    change_info is [NAME,ORGANIZATION,'MAIL CODE',STREET,'CITY STATE ZIP',PH
    ,TITLE,QUIT].

    ask ('Which entry in the below list do you wish to change?',chgwant,?
    change_info).

    if ?chgwant = NAME
      then
      old_name = element(?oldtext,1)
      and
      old_value = string_replace (?old_name,'NAME:              ','',1)
      and
      read_response (['#e #fyellow Your original entry for name was#s', ?old
    Please enter the corrected name in its entirety.#n #o'],new_name,?old_va


    if ?chgwant = NAME
      then
        new_name = concat ('NAME:              ',?new_name)
      and
        oldtext is replace(?oldtext,?old_name,?new_name).


    if ?chgwant = ORGANIZATION
      then
      old_org = element(?oldtext,2)
      and
      old_value = string_replace (?old_org,'ORGANIZATION:     ','',1)
      and
      read_response (['#e #fyellow Your original entry for organization was#
      old_value, '.#d #s #n#n
    Please enter the corrected organization in its entirety.#n'],new_org,?
    old_value).

    if ?chgwant = ORGANIZATION
```

3

```
      then
      new_org = concat ('ORGANIZATION:         ',?new_org)
      and
      oldtext is replace(?oldtext,?old_org,?new_org).


   if ?chgwant = 'MAIL CODE'
      then
      old_mc = element(?oldtext,3)
      and
      old_value = string_replace (?old_mc,'MAIL CODE:             ','',1)
      and
      read_response (['#e #fyellow Your original entry for mail code was#s #
      old_value, '.#d #s #n#n
Please enter the corrected mail code in its entirety.#n'],new_mc,?old_va

   if ?chgwant = 'MAIL CODE'
      then
      new_mc = concat ('MAIL CODE:           ',?new_mc)
      and
      oldtext is replace(?oldtext,?old_mc,?new_mc).


   if ?chgwant = STREET
      then
      old_street = element(?oldtext,4)
      and
      old_value = string_replace (?old_street,'STREET:              ','',1)
      and
      read_response (['#e #fyellow Your original entry for street was#s #n',
      old_value,'.#d #s #n#n
Please enter the corrected street address in its entirety.#n'],new_stree
?old_value).

   if ?chgwant = STREET
      then
      new_street = concat ('STREET:               ',?new_street)
      and
      oldtext is replace(?oldtext,?old_street,?new_street).


   if ?chgwant = 'CITY STATE ZIP'
      then
      old_city = element(?oldtext,5)
      and
      old_value = string_replace (?old_city,'CITY, STATE, ZIP: ','',1)
      and
      read_response (['#e #fyellow Your original entry for city, state and z
      old_value,'.#d #s #n#n
Please enter the corrected city, state, and zip address in its entirety.
new_city,?old_value).

   if ?chgwant = 'CITY STATE ZIP'
      then
      new_city = concat ('CITY, STATE, ZIP: ',?new_city)
```

```
              and
              oldtext is replace(?oldtext,?old_city,?new_city).


        if ?chgwant = PHONE
          then
          old_phone = element(?oldtext,6)
          and
          old_value = string_replace (?old_phone,'PHONE:                ','',1)
          and
          read_response (['#e #fyellow Your original entry for phone was#s #n',
          old_value,'.#d #s #n#n
Please enter the corrected phone number in its entirety.#n'],
new_phone,?old_value).

        if ?chgwant = PHONE
          then
          new_phone = concat ('PHONE:               ',?new_phone)
          and
          oldtext is replace(?oldtext,?old_phone,?new_phone).


        if ?chgwant = 'TITLE'
          then
          say ('#e
          Please enter the corrected title and/or format of your experiment
          in the desired format, i.e. centered, justified, etc.

             Press the #fyellow RETURN KEY#d to enter the editor,
             #fyellow ESC#d to leave the editor, and #fyellow RETURN#d to confirm
          and
             edit_file (concat (C:\GARDEN\,?CURDIR,'\TITLE.DAT'),yellow,black,red


        if ?chgwant = QUIT
          then
             new_file     (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT'))
             and
             write        (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT'),?oldtext,#n)
             and
             close        (concat (C:\GARDEN\,?CURDIR,'\AUTHOR.DAT')).

        if ?chgwant = QUIT
          then
          say
         ([?oldtext,'#fyellow The information listed above was written to the te
          file AUTHOR.DAT.  Please press #flightgreen SPACE#d #fyellow to continu
                                   ']).

end. (* edit_personal *)


end. (* personal_info *)

(* ================== end personal information ========================
```

```
(*INTRO.KB              This is the introductory screen for the          *)
(*                       NASA Automated Payload Element Tool.             *)
(*                       It is used to give the novice user a             *)
(*                       brief tour of the functions of the system.       *)


yn is [YES,NO].

tried = 0.

WRITE ('con:','#e      ').
window (,white,red,yellow,1,14,29,6).

WRITE ('con:',
'During execution of this
application, slight delays
will occur while information
is loaded/unloaded.  These
delays will be indicated by
messages similar to this.').

do (so_you_want_to_fly).

new_kb ('nasa.ckb').

topic so_you_want_to_fly.
  if ?tried = 0
    then load ('nasaterm.hkb').
  close_window ().

  say ('

                    #bmagenta So you want to fly on the Shuttle.#d

               Well, before you can, we must get a little information about
                         your experiment and its objectives.

          If you.have flown with us in the past, you may remember a substanti
          amount of paper documentation was required.  This application, the
          #mAutomated Payload Experiment Tool#m, is a #mprototype#m designed
          alleviate much of the burden of #mexperiment#m preparation by
          utilizing a #mhypertext#m, knowledge-based system.  This system
          can be used to prepare two of our support documents, the
          Science Requirements Document (#mSRD#m), which defines the science
          objectives, and the Engineering Requirements Document (#mERD#m), wh
          defines the engineering design/build requirements.


                         Press #fyellow SPACE#D to continue.').
    if ?tried = 0
      then window (' ',white,red,white) and

          say ('
          For more information on a highlighted topic, just move
          the mouse to that word and click.  The information
```

1

will immediately be displayed. If you are not using a
mouse, please use the function keys as indicated at the
bottom of the screen.

For multiple page definitions, please use the #fyellow Page Up#d
and #fyellow Page Down#d keys to scroll back and forth through
the pages. Multiple page displays are indicated by the
#fyellow Page x of x #d message at the lower right of the screen.

To use the mouse to navigate forward through multiple
pages of information, point to the #fyellow Page x of x #d messag
and click the left mouse-side button. To move back
through multiple screens, point at the #fyellow Page x of x #d
message and click the right-side mouse button.

For help at anytime throughout the application, select
the #fyellow F1#d key. This will retrieve location sensitive
help information, and may be called from the system
or system-called edit screens.

This will be the method by which support documentation
will be retrieved throughout this application.

                         Press #fyellow SPACE#D to continue.')
    and
      close_window ()
    and
      tried = 1
    and
      do (so_you_want_to_fly).

end. (* so_you_want_to_fly *)

```
(*FILLMENU.KB      This is the menu provided to the user to        *)
(*                 determine what he/she is to do on a            *)
(*                              project.                          *)


no_edit_key ().
(* no_debug (). *)
fdaction = '  '.

curdir is read_line ('CURDIR.DAT').
curdir is string_replace (?curdir,' ','',8).

while ?fdaction <> 'Exit System'
  then do (filldoc).

topic 'filldoc'.

fdchoices = ['Enter Project Initialization Information',
          'Complete Science Requirements Document (SRD)',
          'Complete Engineering Requirements Document (ERD)',
          'Return to Previous Menu',
          'Return to Main Menu',
          'Exit System'].

window (,white,red,yellow,5,5,75,16).

  ask (['#e #s
    Please select the activity you wish to perform on #n
    the',?curdir,'#dproject.'],fdaction,?fdchoices).

close_window ().

if ?fdaction = 'Enter Project Initialization Information'
  then new_kb ('initial.hkb').

if ?fdaction = 'Complete Science Requirements Document (SRD)'
  then new_kb ('fillsrd.hkb').

if ?fdaction = 'Complete Engineering Requirements Document (ERD)'
  then new_kb ('fillerd.hkb').

if ?fdaction = 'Return to Main Menu'
  then new_kb ('nasa.ckb').

if ?fdaction = 'Return to Previous Menu'
  then new_kb ('project.hkb').

if ?fdaction = 'Exit System'
  then exit ().
```

```
(*PROJECT.KB        This is the project menu to allow the          *)
(*                   user to define a new project or select         *)
(*                  an existing project.  It then calls             *)
(*                      the  appropriate submenu.                   *)

no_edit_key ().
(* no_debug (). *)
do_gloss = 1.
yn is [YES,NO].

do (firstpass).

if ?project_want = 'RETURN TO MAIN MENU'
  then new_kb ('nasa.ckb').

topic 'firstpass'.
  eof = number_to_char (26).
  projtest is read_line ('projlist.dat').
  if ?projtest = ?eof
    then
      do (new_project)
    else
      projlist is read ('projlist.dat')
    and
      do (old_project).



topic 'new_project'.

window (,white,red,yellow,5,5,75,16).
read_response ('#e
     Please enter an identifier for your project.  This identifier
     should be eight (8) characters or less.  #n ',newproject).

IF ?NEWPROJECT <> [ ] AND ?NEWPROJECT <> ' ' AND ?NEWPROJECT <> ''
  THEN
projlist gets ?newproject
  AND
new_file ('projlist.dat')
  AND
write ('projlist.dat',?projlist)
  AND
close ('projlist.dat')
  AND
DOSCOMMAND = CONCAT('MD ',?NEWPROJECT)
  AND
dos (?DOSCOMMAND,restore).
close_window ().

end. (* new_project *)

topic 'old_project'.

   window (,white, red, yellow, 5,5,75,16).
```

1

```
         choose_project = ?projlist.
         choose_project gets 'ENTER A NEW PROJECT'.
         choose_project gets 'RETURN TO MAIN MENU'.
         ask ('#e
         Please select the project of your choice, or enter a new
         project.',project_want,?choose_project).

     if ?project_want = 'RETURN TO MAIN MENU'
         then new_kb ('nasa.ckb').

       if ?project_want = 'ENTER A NEW PROJECT'
         then do (new_project)
       else
         cur_dir = string_replace(?project_want,' ','',10)
         and
         new_file ('CURDIR.DAT')
         and
         write ('CURDIR.DAT',?cur_dir)
         and
         close ('CURDIR.DAT').

     close_window ().

     end. (* old_project *)

     end. (* firstpass *)


     menu_option is ['FILL OUT DOCUMENTATION','PRINT SRD','PRINT ERD (SECTION
     'COPY ANSWERS TO DISK','RETURN TO MAIN MENU',QUIT].
     menu_choice = ' '.

     while ?menu_choice <> QUIT
       then do (nasamenu).

     topic nasamenu.

       ask (['#e #s
         The project you have selected is:  ',?project_want,'#d #n

         Please enter your choice of activities from the list.'],menu_choice,
             ?menu_option).

     if ?menu_choice = 'FILL OUT DOCUMENTATION'
       then new_kb ('fillmenu.hkb').

     if ?menu_choice = 'RETURN TO MAIN MENU'
       then new_kb ('NASA.CKB').

     if ?menu_choice = 'PRINT SRD'
       then
       window (,white,red,yellow,1,16,27,4)
       and
       write ('con:','PRINTING IN PROGESS...')
       and
```

2

```
      dos ('NASA.EXE')
      and
      dos ('NASAPRN.EXE')
      and
      close_window ().

if ?menu_choice = 'PRINT ERD (SECTION 9)'
   then do (prnerd9).

if ?menu_choice = 'COPY ANSWERS TO DISK'
   then do (copyfiles).

if ?menu_choice = QUIT
   then stop ().

topic prnerd9.
   new_kb ('PRNERD9.HKB').
end.   (* prnerd9 *)

topic 'copyfiles'.

   ask ('Do you want to copy your answers to a different drive?',wantcopy
   if ?wantcopy = YES
      then drivelist is [A:,B:,C:,D:,NONE]
   and
      ask
        ('Please choose the drive to which you wish to copy the files: ',
        drive_destination,?drivelist).

   if ?wantcopy = YES and ?drive_destination <> NONE
      then
        copy_command = concat ('COPY C:\GARDEN\',?cur_dir,'\*.DAT ',?DRIVE
      and
        say ('
        Please insert diskette now if you are copying to a floppy drive.

                       Please press #fyellow SPACE#d when ready.     ')

      and
        move_cursor (1,10)
      and
        dos (?copy_command,restore)
      and
        say ('#e

              Answers have been moved to drive #s',?drive_destination,'

              Please press #fyellow SPACE#d to exit.     ').

   do (nasamenu).


end. (* copyfiles *)
```

```
(* ************************************************************* *)

end.   (* nasamenu *)
```

```
(*FILLSRD.KB        This program is used to allow the user          *)
(*                      to navigate and complete all pertinent       *)
(*                  sections of the Science Requirements Document.    *)

do (nasasys).

topic nasasys.

curdir is read_line ('CURDIR.DAT').
curdir = string_replace(?curdir,' ','',8).

yn is [YES,NO].
chgwant = '   '.
tried = 0.
type_change = '   '.
change_type = '   '.

if ?tried = 0
  then load ('srdterm.hkb').

ask ('
      Have you already begun to fill out the SRD in a previous
      session?',begun,?yn)
and
      if ?begun = NO
        then new_one = ' ' and do (fillSRD)
      else
        type_change is ['CHANGE ONE ITEM','CHANGE AND CONTINUE',
        'COMPLETE UNANSWERED TOPICS',QUIT]
         and

      while ?change_type <> QUIT
        then ask ('
        Do you wish to change only one item, resume at a point
        and continue sequentially through the remainder of the
        SRD, or complete all topics previously unanswered?',
        change_type,?type_change)
        and
        if ?change_type = 'CHANGE ONE ITEM'
          then
            do (SRD_start)
          else
            if ?change_type = 'COMPLETE UNANSWERED TOPICS'
              then
                do (SRD_complete)
              else
                if ?change_type = 'CHANGE AND CONTINUE'
                then
                  resume = 1 and
                  choice = ' ' and
                  do (SRD_continue)
                else
                  new_kb ('fillmenu.hkb').

      if ?change_type = QUIT
```

```
                then new_kb ('fillmenu.hkb').


   topic 'SRD_start'.
     resume = 1.
     choice = ' '.
     while ?choice <> Quit
       then do (SRD_begin).
     close_window ().
     WRITE ('con:','#e        ').
     reset (SRD_begin).
     collect ().
   end. (* SRD_start *)


   (* ******************** BEGIN FILLING OUT SRD ***********************
   topic 'fillSRD'.
       if ?new_one = ' '
         then load ('srdquest.hkb')
         and fs gets children(fillSRD)
         and fs is remove (?fs,'related answer')
         and stopSRD = 'N'
         and new_one = 'X'
         and x = 1.

     y = (element(?fs,?x)).

     if ?y <> ' ' and ?stopSRD <> 'Y'
       then do (?y).
     x = ?x + 1.
     if ?x = 8
       or ?x = 16
         or ?x = 24
           or ?x = 32
             then collect ().
     WRITE ('con:','#e        ').
     if ?y = last(?fs)
       then stopSRD = 'Y'.

     if ?stopSRD <> 'Y'
       then do (fillSRD).

   end. (* fillSRD *)

   (* *******************************************************************

   topic 'SRD_begin'.
   if ?resume = 1
     then load ('srdquest.hkb').

     window ('Which subtopic do you wish to change?',blue,white,white).
       if ?resume = 1
         then begin is 'Quit'.
       if ?resume = 1
         then begin gets children(SRD_begin).
```

```
         if ?resume = 1
           then begin gets 'Quit'
           and
           begin is remove (?begin,'related answer')
           and
           choice = ' '.

      while ?choice <> Quit
        then
           ask ('Which subtopic you wish to change?',choice,  ?begin)
           and
            if ?choice <> 'Quit'
              then do (?choice)
           and
            resume = 2
           and
           close_window ().
      if ?choice = 'Quit'
        then
           window (,white,red,yellow,1,16,27,4) and
           WRITE ('con:',
'A slight delay will occur
while the next segment of
this application is loaded.
Please stand by.            ') and
           stop_at = where (?begin,Quit,2) and
           kounter = 1 and
           stop_at = remove(?stop_at,1) and
           while ?kounter < ?stop_at
              then
                 eraser = element (?begin,?kounter) and
                 remove_topic (?eraser) and
                 kounter = ?kounter + 1.

end. (* SRD_begin *)

(* ******************** RESUME FILLING OUT SRD ***********************

topic 'SRD_continue'.
    choice = '    '.

    if ?resume = 1
      then load ('srdquest.hkb').

    window ('
      Where do you wish to resume?',blue,white,white).

    if ?resume = 1
      then continue is children (SRD_continue).

    if ?resume = 1
      then continue gets 'Quit'
      and continue is remove (?continue,'related answer').

    ask ('With which subtopic you wish to resume your activity?',
```

```
          choice, ?continue).


       if ?choice <> 'Quit'
         then
           cont_where = where(?continue,?choice) and
           ckount = 1 and
           while ?ckount < ?cont_where
             then
               rem_top = element(?continue,?ckount) and
               remove_topic (?rem_top) and
               ckount = ?ckount + 1.

       collect ().

       while ?choice <> 'Quit'
         then choice = element(?continue,?ckount) and
           if ?choice <> ' ' and ?choice <> 'Quit'
             then do (?choice) and
                   ckount = ?ckount + 1
                     and remove_topic (?choice)
                       and if ?ckount = 8
                             or ?ckount = 16
                               or ?ckount = 24
                                 or ?ckount = 32
                                   then collect ().
       resume = 2.
       close_window ().

       WRITE ('con:','#e       ').

   end. (* SRD_continue *)

(* **************************************************************************
topic 'SRD_complete'.

   close (concat (C:\GARDEN\,?curdir,'\LISTING.OUT')).
   dos (search,restore).
   eof = number_to_char (26).
   searchtext is read_line (concat (C:\GARDEN\,?CURDIR,'\LISTING.OUT')).
   if ?searchtext = ?eof
     then
       window (,white,red,yellow,10,10,60,8)
       and
       say
       ('#e

   All required sections of the SRD have been addressed.
   Please use the CHANGE ONE ITEM option to choose
   individual items to edit.

       Please press the SPACE key to continue.')
       and
         bypass_unload = Y
       and
```

```
                close_window ()
        else
          load ('SRDQUEST.HKB')
          and
          searchlist is read
            (concat (C:\GARDEN\,?curdir,'\LISTING.OUT'))
          and
            close (concat (C:\GARDEN\,?curdir,'\LISTING.OUT'))
          and
            searchlist gets 'Quit'
          and
            chgwant = '     '
          and
            while ?chgwant <> Quit
              then do (complete_SRD).

    if ?bypass_unload <> Y
      then
        window (,white,red,yellow,1,16,27,4)
        and
        WRITE ('con:',
'A slight delay will occur
while the remainder of the
application is loaded.
Please stand by.             ')
        and
        stop_at = where (?searchlist,Quit,2) and
        kounter = 1 and
        stop_at = remove(?stop_at,1) and
        while ?kounter < ?stop_at
          then
            eraser = element (?searchlist,?kounter) and
            remove_topic (?eraser) and
            kounter = ?kounter + 1.
    close_window ().



(* ********************************************************************* *)

topic 'complete_SRD'.

  bypass_unload = N.
  window ('Which subtopic do you wish to complete?',blue,white,white).
  complete is 'Quit'.
  complete gets ?searchlist.
  ask ('#e
      These subtopics have not yet been addressed.  Please
      choose the one you wish to complete, or choose Quit
      to exit this screen.',chgwant,?complete).
  if ?chgwant <> Quit
    then do (?chgwant).
  close (concat (C:\GARDEN\,?curdir,'\LISTING.OUT')).
  if ?chgwant <> Quit
    then dos (search, restore).
```

5

```
        close (concat (C:\GARDEN\,?curdir,'\LISTING.OUT')).
        searchtext is read_line (concat (C:\GARDEN\,?curdir,'\LISTING.OUT')).
        if ?searchtext = ?eof
          then
            window (,white,red,yellow,10,10,60,8)
            and
            say
            ('#e
        All required sections of the SRD have now been
        addressed.  Please use the CHANGE ONE ITEM
        option to choose individual items to edit.')
            and
              close_window ()
            and
              chgwant = 'Quit'
          else
            searchlist is read
              (concat (C:\GARDEN\,?curdir,'\LISTING.OUT'))
            and
              searchlist gets 'Quit'.
      close_window ().

end. (* complete_SRD *)

end. (* SRD_complete *)

(* ****************************************************************** *)

end. (* nasasys *)
```

```
(*FILLERD.KB        This program is used to allow the user              *)
(*                    to complete the various sections of               *)
(*                  Engineering Requirements Document.                  *)


no_edit_key ().
(* no_debug (). *)
curdir is read_line ('CURDIR.DAT').
curdir = string_replace(?curdir,' ','',8).

yn is [YES,NO].
load ('erdterm.hkb').

do (outline).

new_kb ('fillmenu.hkb').

topic outline.
    say ('
            The suggested outline for the Engineering Requirements
            Document (#mERD#m) is as follows.  Please choose the
            section with which you would like to begin/resume:

            1  #mFunction Objectives & Equipment Identification#m

            2  #mStructural/Mechanical#m

            3  #mPointing/Stabilization and Alignment#m

            4  #mOrbital Requirements and Constraints#m

            5  #mElectrical Requirements#m

            6  #mThermal Control/Fluid Requirements#m




            7   #mData System Requirements#m

            8   #mFlight Software Requirements#m

            9   #mPhysical Integration#m

           10   #mMission Operations Support#m

           11   #mTraining Objectives#m

           12   #mEnvironmental Contamination Data Requirements#m

                #mAppendix#m (Abbrevations and Acronyms)


            Press #fyellow SPACE#d to return to Main Program Module
```

```
(* ==========================threaded topics================== *)

topic 'Function Objectives & Equipment Identification'.
        window ('1.0  Functional Objectives & Equipment Identification',bl
        white).

           say ('
                1.1 Functional Objectives

                1.2 Experiment Functional Objectives

                1.3 Operational Function Flow

                            Press #fyellow SPACE#d to continue.').
           close_window ().

end. (* Functional Objectives *)

topic 'Structural/Mechanical'.
        window ('2.0  Structural/Mechanical',blue,white,white).

           say ('
                Structual/Mechanical Section is not further
                subdivided.

                            Press #fyellow SPACE#d to continue.').
           close_window ().

end. (* Structural/Mechanical *)


topic 'Pointing/Stabilization and Alignment'.
        window ('3.0  Pointing/Stabilization and Alignment',blue,white,
        white).

           say('
                3.1 Pointing requirements

                3.2 Stabilization requirements

                3.3 Viewing requirements

                3.4 IPS pointing requirements

                3.5 Experiment pointing capabilities

                3.6 On-Orbit acceleration and vibration limits

                3.7 Alignment requirements

                3.8 Coalignment requirements

                            Press #fyellow SPACE#d to continue.').
```

```
        close_window ().

end. (* Pointing/Stabilization *)


    topic 'Orbital Requirements and Constraints'.
        window ('4.0   Requirements and Constraints',blue,white,white).

        say('

            4.1 Desired orbit characteristics

            4.2 Earth and Celestial target

            4.3 Viewing requirements and constraints

            4.4 Vehicle motion and G-level limits

                        Press #fyellow SPACE#d to continue.').
        close_window ().

end. (* Orbital Requirements *)

    topic 'Electrical Requirements'.
        window ('5.0   Electrical Requirements',blue,white,white).

        say ('
            Electrical Requirements Section is not further
            subdivided.

                        Press #fyellow SPACE#d to continue.').
        close_window ().

end. (* Electrical Requirements *)

    topic 'Thermal Control/Fluid Requirements'.
        window ('6.0   Control/Fluid Requirements',blue,white,white).

        say ('
            6.1 Model equipment requirements

            6.2 Pallet/Airlock requirements

            6.3 Fluid requirements

                        Press #fyellow SPACE#d to continue.').
        close_window ().

end. (* Thermal Control *)

    topic 'Data System Requirements'.
        window ('7.0   Data System Requirements',blue,white,white).

        say ('
```

7.1 Signal interface definition

        7.2 Signal interface definition expansion

        7.3 Display requirements

        7.4 Event/Eception monitor requirements

        7.5 Direct HRM, Analog, Video, and MTU requirements

        7.6 Processed dedicated HRM channel parameter definitions

        7.7 #mPOCC#m display requirements

        7.8 #mPOCC#m limit sensing/exception monitor requirements

                        Press #fyellow SPACE#d to continue.').
        close_window ().

end. (* Data System *)

topic 'Flight Software Requirements'.
     window ('8.0 Flight Software Requirements',blue,white,white).

     say ('
          Flight Software Requirements Section is not further
          subdivided.

                        Press #fyellow SPACE#d to continue.').
        close_window ().

end. (* Flight Software Requirements *)

topic 'Physical Integration'.
   window ('9.0 Physical Integration',blue,white,white,6,4,65,15).

   ask ('
      The suggested outline for #mERD Section 9#m consists of the
      following:

          9.1 Experiment/Facility requirements

          9.2 Integration of experiment

      Do you wish to begin/continue filling out this section.',start9,?y

   if ?start9 = YES
     then
     option9 is ['9.1 Experiment/Facility requirements',
     '9.2 Integration of experiment',QUIT]
     and
     ask
   ('
With which subheading do you wish to begin?',choice9,?option9).

```
   if ?start9 = NO
     then choice9 = '   '.

   if ?choice9 = '9.1 Experiment/Facility requirements'
     then do ('ERD9.1')
     and reset ('ERD9.1')
     and collect ().

   if ?choice9 = '9.2 Integration of experiment'
     then do ('ERD9.2')
     and reset ('ERD9.2')
     and collect ().

   close_window ().

end. (* Physical Integration *)

topic 'Mission Operations Support'.
     window ('10.0  Mission Operations Support',blue,white,white).

     say('
         10.1 Narrative description

         10.2 Facilities

         10.3 Data product format

         10.4 HRM channel formats

                        Press #fyellow SPACE#d to continue.').
     close_window ().

end. (*Mission Operations*)

topic 'Training Objectives'.
     window ('11.0  Training Objectives',blue,white,white).

     say ('
         11.1 Training participation

         11.2 Training objectives

             Press #fyellow SPACE#d to continue.').
     close_window ().

end. (*Training Objectives*)

topic 'Environmental Contamination Data Requirements'.
     window ('12.0  Environmental Contamination Data Requirements',blue
     white).

     say ('
     12.1 Flight environmental limits
```

```
                  12.2 On-Orbit external contamination control sensitivity

                  12.3 External contamination sources

                        Press #fyellow SPACE#d to continue.').

            close_window ().

    end.  (*Environment Contamination*)

    topic appendix.
      appendix = QUIT.
      appendix gets children(!main).
      appendix is remove (?appendix,[term_choice,yn,curdir,outline]).
      window ('Appendix',blue,white,white).

      ask ('
        Please choose the word or term that you desire to look up.',
        term_choice,?appendix).
      if ?term_choice <> QUIT
        then do (?term_choice)
        and
        close_window ()
        and
        do (appendix).
      close_window ().

    end. (* appendix *)

    topic 'ERD Section 9'.

      window ('9.0  Physical Integration',blue,white,white,6,4,65,13).

      say ('
      The physical integration requirements are those requirements
      associated with the hardware/software integration, checkout,
      launch, and deintegration of experiments or flight facilities
      with the Space Transportation System.  It is necessary that
      the developers of the hardware for the experiments or flight
      facilities identify their requirements for these integration
      operations.  The information requested in the subsequent
      paragraphs is that information required in the early phases
      of development to determine compatibility/incompatibility
      of the integrated requirements with the capabilities at
      #mKSC#m as defined in #mKCS IV 0018.0#m, Payload Developer''s
      Guide for Launch Site Operations (Attached Payloads).

      As the program progresses, more detailed information will be
      required to implement the integrated payload requirements.
      This information shall be contained in the #mO&IA#m.

                     Press #fyellow SPACE#d to continue.').

      close_window ().
```

```
end. (* ERD Section 9 *)


topic 'ERD9.1'.

  window ('9.1  Experiment/Facility requirements',blue,white,white,6,4,6

  say ('
     The ground processing of an integrated payload is generally
     accomplished in four steps:
                    1.   #mExperiment/Facility Preintegration#m
                    2.   #mExperiment Integration#m
                    3.   #mPayload Integration#m
                    4.   #mExperiment Deintegration#m

     Throughout the payload development and integration cycle,
     it will be necessary for the #mPED#m to define his
     #mrequirement#ms associated with the activities defined
     in the above four steps.  The following questions/
     responses will describe the information necessary to
     determine the overall compatibility of the PED planning
     with existing #mKSC#m capabilities and planning.

                  Press #fyellow SPACE#d to continue.').


(*                    QUESTION 9 PART 1 OPTION 1                    *)

ask ('#e
     Do you plan to perform any postshipment assembly, test,
     calibration, or servicing to prepare your equipment for
     integration?',answer,?yn).

if ?answer = YES
  then
     load ('ERDQ911.hkb')
     and
     do (ERD_9_1_1)
     and
     remove_topic (ERD_9_1_1)
     and
     collect ()
  else
     eof = number_to_char (26)
     and
     q911ck = read_line  (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT'))
     and
     close (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT'))
     and
     if ?q911ck <> ?eof
       then
       reset (q911ck)
       and
       ask ('
       There are answers on file that indicate this question
```

```
        was previously answered YES, rather than NO.  If the
        correct answer is NO, the system will need to erase the
        ans:ers from your previous session that were directly
        related to the YES response, since they are no longer
        applicable.  Do you authorize the system to discard
        these previous answers?',q911kill,?yn)
    and
      if ?q911kill = YES
        then
          delfile = (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT'))
          and
          dos (concat('del ',?delfile,'.'),restore)
          and
          delfile = (concat (C:\GARDEN\,?CURDIR,'\ERD911.DAT'))
          and
          dos (concat('del ',?delfile,'.'),restore)
          and
          delfile = (concat (C:\GARDEN\,?CURDIR,'\OTHERGAS.DAT'))
          and
          dos (concat('del ',?delfile,'.'),restore)
          and
          delfile = (concat (C:\GARDEN\,?CURDIR,'\LIQUIDS.DAT'))
          and
          dos (concat('del ',?delfile,'.'),restore)
          and
          delfile = (concat (C:\GARDEN\,?CURDIR,'\NSENVIRO.DAT'))
          and
          dos (concat('del ',?delfile,'.'),restore)
          and
          delfile = (concat (C:\GARDEN\,?CURDIR,'\OFSDESC.DAT'))
          and
          dos (concat('del ',?delfile,'.'),restore).

close ('ERDQ911.hkb').

(*                    QUESTION 9 PART 1 OPTION 2                    *)

ask ('#e
    Do you plan to perform any activities at #mKSC#m with your
    equipment that cannot be performed in the same area or in
    conjunction with your hardware preparation?  ',answer,?yn).

if ?answer = YES
  then
    load ('ERDQ912.hkb')
    and
    do (ERD_9_1_2)
    and
    remove_topic (ERD_9_1_2)      .
    and
    collect ()
  else
    eof = number_to_char (26)
    and
    q912ck = read_line (concat (C:\GARDEN\,?CURDIR,'\ERDQ912.DAT'))
```

```
      and
      close (concat (C:\GARDEN\,?CURDIR,'\ERDQ912.DAT'))
      and
      if ?q912ck <> ?eof
        then
        reset (q912ck)
        and
        ask ('
There are answers on file that indicate this question
was previously answered YES, rather than NO.  If the
correct answer is NO, the system will need to erase the
answers from your previous session that were directly
related to the YES response, since they are no longer
applicable.  Do you authorize the system to discard
these previous answers?',q912kill,?yn)
      and
        if ?q912kill = YES
          then
             delfile = (concat (C:\GARDEN\,?CURDIR,'\ERDQ912.DAT'))
             and
             dos (concat('del ',?delfile,'.'),restore)
             and
             delfile = (concat (C:\GARDEN\,?CURDIR,'\ERD912.DAT'))
             and
             dos (concat('del ',?delfile,'.'),restore)
             and
             delfile = (concat (C:\GARDEN\,?CURDIR,'\OTH92GAS.DAT'))
             and
             dos (concat('del ',?delfile,'.'),restore)
             and
             delfile (concat (C:\GARDEN\,?CURDIR,'\LIQUI92.DAT'))
             and
             dos (concat('del ',?delfile,'.'),restore)
             and
             delfile (concat (C:\GARDEN\,?CURDIR,'\NSENVI92.DAT'))
             and
             dos (concat('del ',?delfile,'.'),restore)
             and              .
             delfile (concat (C:\GARDEN\,?CURDIR,'\OFSDE92.DAT'))
             and
             dos (concat('del ',?delfile,'.'),restore).

close ('ERDQ912.hkb').

(*                    QUESTION 9 PART 1 OPTION 3                    *)

ask ('#e
After landing, the nominal time for removal of experiment/
facilities will be 2 to 3 weeks.  If you have any require-
ments for removal that are earlier than this time, answer
YES and describe them by responding to the follow-on questions.
Also, the planned mode of operation for experiment/facility
hardware is to remove the equipment and immediately return to
the #mPED#m for shipment.  If you have any requirements for
postmission test or calibration of the experiment/facility
```

```
equipment, answer YES and respond to the follow-on questions.',
answer,?yn).


if ?answer = YES
   then
      load ('ERDQ913.hkb')
      and
      do (ERD_9_1_3)
      and
      remove_topic (ERD_9_1_3)
      and
      collect ()
   else
      eof = number_to_char (26)
      and
      q913ck = read_line (concat (C:\GARDEN\,?CURDIR,'\ERDQ913.DAT'))
      and
      close (C:\GARDEN\,?CURDIR,'\ERDQ913.DAT')
      and
      if ?q913ck <> ?eof
         then
         reset (q913ck)
         and
         ask ('
         There are answers on file that indicate this question
         was previously answered YES, rather than NO.  If the
         correct answer is NO, the system will need to erase the
         answers from your previous session that were directly
         related to the YES response, since they are no longer
         applicable.  Do you authorize the system to discard
         these previous answers?',q913kill,?yn)
      and
         if ?q913kill = YES
            then
               delfile = (concat (C:\GARDEN\,?CURDIR,'\ERDQ913.DAT'))
               and
               dos (concat('del ',?delfile,'.'),restore)
               and
               delfile = (concat (C:\GARDEN\,?CURDIR,'\ERD913.DAT'))
               and
               dos (concat('del ',?delfile,'.'),restore)
               and
               delfile = (concat (C:\GARDEN\,?CURDIR,'\OTH93GAS.DAT'))
               and
               dos (concat('del ',?delfile,'.'),restore)
               and
               delfile = (concat (C:\GARDEN\,?CURDIR,'\LIQUI93.DAT'))
               and
               dos (concat('del ',?delfile,'.'),restore)
               and
               delfile = (concat (C:\GARDEN\,?CURDIR,'\NSENVI93.DAT'))
               and
               dos (concat('del ',?delfile,'.'),restore)
               and
```

10

```
            delfile = (concat (C:\GARDEN\,?CURDIR,'\OFSDE93.DAT'))
            and
            dos (concat('del ',?delfile,'.'),restore).

   close ('ERDQ913.hkb').

   end. (* ERD9.1 *)


   (*                        QUESTION 9 PART 2                        *)

   topic 'ERD9.2'.

      window ('9.2  Integration of Experiment',blue,white,white,6,4,65,15).

      ask ('
          During the integration of experiments with the carrier and
          Orbiter, there may be special requirements associated with
          an effect on normal planned activities.  The #mPED#m should
          complete the following section to describe those activities
          peculiar to the experiment/facility.

             Do you wish to complete this section now?',ERD92now,?yn).

   if ?ERD92now = YES
     then
       load ('ERDQ92.hkb')
       and
       do (ERD_9_2_1).

   close ('ERDQ92.hkb').

   end.  (* ERD9.2 *)

   end. (* outline *)
```

```
(*                    OUTLINE FOR THE ERD                          *)
(* ERDQUEST.KB is the knowledge base called from the NASAREVn.KB.  *)
(* It is loaded whenever the user wishes to fill out the Engineering *)
(* Document.  An outline of the ERD is presented, with the user    *)
(* selecting the section with which he/she will begin.             *)


topic outline.
      say ('
            The suggested outline for the Engineering Requirements
            Document (#mERD#m) is as follows.  Please choose the
            section with which you would like to begin/resume:

        1 #mFunction Objectives & Equipment Identification#m

        2 #mStructural/Mechanical#m

        3 #mPointing/Stabilization and Alignment#m

        4 #mOrbital Requirements and Constraints#m

        5 #mElectrical Requirements#m

        6 #mThermal Control/Fluid Requirements#m



        7   #mData System Requirements#m

        8   #mFlight Software Requirements#m

        9   #mPhysical Integration#m

        10  #mMission Operations Support#m

        11  #mTraining Objectives#m

        12  #mEnvironmental Contamination Data Requirements#m

            #mAppendix#m (Abbrevations and Acronyms)


            Press #fyellow SPACE#d to return to Main Program Module



(* =============================threaded topics=================== *)

topic 'Function Objectives & Equipment Identification'.
      window ('1.0  Functional Objectives & Equipment Identification',bl
      white).

         say ('
               1.1 Functional Objectives
```

1

```
                1.2 Experiment Functional Objectives

                1.3 Operational Function Flow

                        Press #fyellow SPACE#d to continue.').
          close_window ().

end. (* Functional Objectives *)

topic 'Structural/Mechanical'.
      window ('2.0  Structural/Mechanical',blue,white,white).

      say ('
          Structual/Mechanical Section is not further
          subdivided.

                        Press #fyellow SPACE#d to continue.').
          close_window ().

end. (* Structural/Mechanical *)


topic 'Pointing/Stabilization and Alignment'.
      window ('3.0  Pointing/Stabilization and Alignment',blue,white,
      white).

      say('
          3.1 Pointing requirements

          3.2 Stabilization requirements

          3.3 Viewing requirements

          3.4 IPS pointing requirements

          3.5 Experiment pointing capabilities

          3.6 On-Orbit acceleration and vibration limits

          3.7 Alignment requirements

          3.8 Coalignment requirements

                        Press #fyellow SPACE#d to continue.').
          close_window ().

end. (* Pointing/Stabilization *)


topic 'Orbital Requirements and Constraints'.
      window ('4.0  Requirements and Constraints',blue,white,white).

      say('
```

```
                4.1 Desired orbit characteristics

                4.2 Earth and Celestial target

                4.3 Viewing requirements and constraints

                4.4 Vehicle motion and G-level limits

                          Press #fyellow SPACE#d to continue.').
          close_window ().

end.  (* Orbital Requirements *)

topic 'Electrical Requirements'.
          window ('5.0   Electrical Requirements',blue,white,white).

          say ('
                Electrical Requirements Section is not further
                subdivided.

                          Press #fyellow SPACE#d to continue.').
          close_window ().

end.  (* Electrical Requirements *)

topic 'Thermal Control/Fluid Requirements'.
          window ('6.0   Control/Fluid Requirements',blue,white,white).

          say ('
                6.1 Model equipment requirements

                6.2 Pallet/Airlock requirements

                6.3 Fluid requirements

                          Press #fyellow SPACE#d to continue.').
          close_window ().

end.  (* Thermal Control *)

topic 'Data System Requirements'.
          window ('7.0   Data System Requirements',blue,white,white).

          say ('

          7.1 Signal interface definition

          7.2 Signal interface definition expansion

          7.3 Display requirements

          7.4 Event/Eception monitor requirements

          7.5 Direct HRM, Analog, Video, and MTU requirements
```

```
            7.6 Processed dedicated HRM channel parameter definitions

            7.7 #mPOCC#m display requirements

            7.8 #mPOCC#m limit sensing/exception monitor requirements

                            Press #fyellow SPACE#d to continue.').
         close_window ().

end. (* Data System *)

topic 'Flight Software Requirements'.
      window ('8.0  Flight Software Requirements',blue,white,white).

      say ('
            Flight Software Requirements Section is not further
            subdivided.

                            Press #fyellow SPACE#d to continue.').
         close_window ().

end. (* Flight Software Requirements *)

topic 'Physical Integration'.
   window ('9.0  Physical Integration',blue,white,white,6,4,65,15).

   ask ('
      The suggested outline for #mERD Section 9#m consists of the
      following:

            9.1 Experiment/Facility requirements

            9.2 Integration of experiment

      Do you wish to begin/continue filling out this section.',start9,?)

   if ?start9 = YES
     then
     option9 is ['9.1 Experiment/Facility requirements',
     '9.2 Integration of experiment',QUIT]
     and
     ask
   ('
   With which subheading do you wish to begin?',choice9,?option9).

   if ?start9 = NO
     then choice9 = '   '.

   if ?choice9 = '9.1 Experiment/Facility requirements'
     then do ('ERD9.1')
     and reset ('ERD9.1')
     and collect ().

   if ?choice9 = '9.2 Integration of experiment'
```

4

```
        then do ('ERD9.2')
        and reset ('ERD9.2')
        and collect ().

    close_window ().

end. (* Physical Integration *)

topic 'Mission Operations Support'.
        window ('10.0   Mission Operations Support',blue,white,white).

        say('
            10.1 Narrative description

            10.2 Facilities

            10.3 Data product format

            10.4 HRM channel formats

                        Press #fyellow SPACE#d to continue.').
        close_window ().

end. (*Mission Operations*)

topic 'Training Objectives'.
        window ('11.0   Training Objectives',blue,white,white).

        say ('
            11.1 Training participation

            11.2 Training objectives

                Press #fyellow SPACE#d to continue.').
        close_window ().

end. (*Training Objectives*)

topic 'Environmental Contamination Data Requirements'.
        window ('12.0   Environmental Contamination Data Requirements',blue
        white).

        say ('
        12.1 Flight environmental limits

        12.2 On-Orbit external contamination control sensitivity

        12.3 External contamination sources

                    Press #fyellow SPACE#d to continue.').

        close_window ().

end. (*Environment Contamination*)
```

```
topic appendix.
  appendix = QUIT.
  appendix gets children(so_you_want_to_fly).
  appendix is remove (?appendix,[SRD_start,fillSRD,SRD_begin,
    choice_ERD,prototype,hypertext,SRD_continue,copyfiles,outline]).
  window ('Appendix',blue,white,white).

  ask ('
    Please choose the word or term that you desire to look up.',
     term_choice,?appendix).
  if ?term_choice <> QUIT
    then do (?term_choice)
    and
    close_window ()
    and
    do (appendix).
  close_window ().

end. (* appendix *)

topic 'ERD Section 9'.

  window ('9.0  Physical Integration',blue,white,white,6,4,65,13).

  say ('
The physical integration requirements are those requirements
associated with the hardware/software integration, checkout,
launch, and deintegration of experiments or flight facilities
with the Space Transportation System.  It is necessary that
the developers of the hardware for the experiments or flight
facilities identify their requirements for these integration
operations.  The information requested in the subsequent
paragraphs is that information required in the early phases
of development to determine compatibility/incompatibility
of the integrated requirements with the capabilities at
#mKSC#m as defined in #mKCS IV 0018.0#m, Payload Developer''s
Guide for Launch Site Operations (Attached Payloads).

As the program progresses, more detailed information will be
required to implement the integrated payload requirements.
This information shall be contained in the #mO&IA#m.

                Press #fyellow SPACE#d to continue.').

  close_window ().

end. (* ERD Section 9 *)


topic 'ERD9.1'.

  window ('9.1  Experiment/Facility requirements',blue,white,white,6,4,6

  say ('
    The ground processing of an integrated payload is generally
```

```
                      accomplished in four steps:
                              1.  #mExperiment/Facility Preintegration#m
                              2.  #mExperiment Integration#m
                              3.  #mPayload Integration#m
                              4.  #mExperiment Deintegration#m

             Throughout the payload development and integration cycle,
             it will be necessary for the #mPED#m to define his
             #mrequirement#ms associated with the activities defined
             in the above four steps.  The following questions/
             responses will describe the information necessary to
             determine the overall compatibility of the PED planning
             with existing #mKSC#m capabilities and planning.

                      Press #fyellow SPACE#d to continue.').


   (*                       QUESTION 9 PART 1 OPTION 1                      *)

ask ('#e
      Do you plan to perform any postshipment assembly, test,
      calibration, or servicing to prepare your equipment for
      integration?',answer,?yn).

if ?answer = YES
  then
     load ('ERDQ911.hkb')
     and
     do (ERD_9_1_1)
     and
     remove_topic (ERD_9_1_1)
     and
     collect ()
  else
     eof = number_to_char (26)
     and
     q911ck = read_line  (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT'))
     and
     if ?q911ck <> ?eof
       then
       ask ('
       There are answers on file that indicate this question
       was previously answered YES, rather than NO.  If the
       correct answer is NO, the system will need to erase the
       answers from your previous session that were directly
       related to the YES response, since they are no longer
       applicable.  Do you authorize the system to discard
       these previous answers?',q911kill,?yn)
     and
       if ?q911kill = YES
         then
            dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT')))
            and
            dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\ERD911.DAT')))
            and
```

```
                 dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\OTHERGAS.DAT')))
                 and
                 dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\LIQUIDS.DAT')))
                 and
                 dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\NSENVIRO.DAT')))
                 and
                 dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\OFSDESC.DAT'))).

close ('ERDQ911.hkb').

(*                  QUESTION 9 PART 1 OPTION 2                      *)

ask ('#e
     Do you plan to perform any activities at #mKSC#m with your
     equipment that cannot be performed in the same area or in
     conjunction with your hardware preparation?  ',answer,?yn).

if ?answer = YES
  then
    load ('ERDQ912.hkb')
    and
    do (ERD_9_1_2)
    and
    remove_topic (ERD_9_1_2)
    and
    collect ()
  else
    eof = number_to_char (26)
    and
    q912ck = read_line (concat (C:\GARDEN\,?CURDIR,'\ERDQ912.DAT'))
    and
    if ?q912ck <> ?eof
      then
      ask ('
      There are answers on file that indicate this question
      was previously answered YES, rather than NO.  If the
      correct answer is NO, the system will need to erase the
      answers from your previous session that were directly
      related to the YES response, since they are no longer
      applicable.  Do you authorize the system to discard
      these previous answers?',q912kill,?yn)
    and
      if ?q912kill = YES
        then
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\ERDQ912.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\ERD912.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\OTH92GAS.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\LIQUI92.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\NSENVI92.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\OFSDE92.DAT'))).
```

8

```
close ('ERDQ912.hkb').

(*                    QUESTION 9 PART 1 OPTION 3                    *)

ask ('#e
 After landing, the nominal time for removal of experiment/
 facilities will be 2 to 3 weeks.  If you have any require-
 ments for removal that are earlier than this time, answer
 YES and describe them by responding to the follow-on questions.
 Also, the planned mode of operation for experiment/facility
 hardware is to remove the equipment and immediately return to
 the #mPED#m for shipment.  If you have any requirements for
 postmission test or calibration of the experiment/facility
 equipment, answer YES and respond to the follow-on questions.',
 answer,?yn).


if ?answer = YES
  then
    load ('ERDQ913.hkb')
    and
    do (ERD_9_1_3)
    and
    remove_topic (ERD_9_1_3)
    and
    collect ()
  else
    eof = number_to_char (26)
    and
    q913ck = read_line (concat (C:\GARDEN\,?CURDIR,'\ERDQ913.DAT'))
    and
    if ?q913ck <> ?eof
      then
      ask ('
      There are answers on file that indicate this question
      was previously answered YES, rather than NO.  If the
      correct answer is NO, the system will need to erase the
      answers from your previous session that were directly
      related to the YES response, since they are no longer
      applicable.  Do you authorize the system to discard
      these previous answers?',q913kill,?yn)
    and
      if ?q913kill = YES
        then
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\ERDQ913.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\ERD913.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\OTH93GAS.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\LIQUI93.DAT')))
          and
          dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\NSENVI93.DAT')))
          and
```

```
                dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\OFSDE93.DAT'))).

close ('ERDQ913.hkb').

end. (* ERD9.1 *)


(*                      QUESTION 9 PART 2                          *)

topic 'ERD9.2'.

   window ('9.2  Integration of Experiment',blue,white,white,6,4,65,15).

   ask ('
      During the integration of experiments with the carrier and
      Orbiter, there may be special requirements associated with
      an effect on normal planned activities.  The #mPED#m should
      complete the following section to describe those activities
      peculiar to the experiment/facility.

         Do you wish to complete this section now?',ERD92now,?yn).

if ?ERD92now = YES
   then
      load ('ERDQ92.hkb')
      and
      do (ERD_9_2_1).

close ('ERDQ92.hkb').

end.   (* ERD9.2 *)

end. (* outline *)
```

```
(* ERDTERM.KB        These are the terms to be loaded in the      *)
(*                     NASA prototype system to aid in the         *)
(*                   development of NASA Engineering Requirements   *)
(*                   Documents for preflight planning and control.  *)

topic 'ac'.
   window ('ac',blue,white,white).

   say ('

        Alternating Current

                Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* ac *)

topic 'ASE'.
   window ('Airborne support equipment',blue,white,white).

   say ('

        ASE - Airborne support equipment.  The flight equipment
        and systems needed to support the payload such as data
        recording, control functions, instrumentation, and
        payload cradles.

                Press #fdarkgray SPACE#D to continue.').

   close_window ().
   end. (* ASE *)

topic 'dc'.
   window ('dc',blue,white,white).

   say ('

        Direct Current

                Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* dc *)

topic 'ECAS'.
   window ('ECAS',blue,white,white).

   say ('

        Experiment Computer Applications Software

            Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* ECAS *)
```

```
topic 'EPED'.
   window ('Experiment Payload Element Developer (EPED)',blue,white,white

   say ('
        The Experiment Payload Element Developer is responsible
        for the design, development, and delivery of instruments
        or experiment facilities (#mpayload element#ms) that will
        satisfy the requirements of a #mPI#m or group of PIs.  The
        EPED hardware/software must also satisfy the safety and
        interface requirements/constraints of other mission
        hardware, including #mSTS#m flight and ground systems.  The
        EPEDs are responsible for support to the #mPMM#m during all
        phases of integration and operation of his equipment.

             Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* EPED *)

topic 'ERD'.
   window ('Engineering Requirements Document',blue,white,white).

   say ('

        The Engineering Requirements Document is used by the
        #mpayload element developer#m and/or the principal
        investigator to define #mexperiment#m requirements to be
        accommodated by the Space Transportation System (STS)
        for a given mission.


                      Press #fdarkgray SPACE#D to continue.').
   close_window ().
end. (* ERD *)

topic 'experiment'.
   window ('Experiment',blue,white,white).

   say ('

        That science activity which is going to be performed
        using a set of hardware.  This activity is defined
        by the Principal Investigator and leads to a set of
        science requirements which the #mhardware#m must meet
        in order to perform the experiment.

             Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* experiment *)

topic 'Experiment Deintegration'.
   window ('Experiment Deintegration',blue,white,white).
```

```
    say ('

    These are the activities by which the experiment hardware
    is removed and turned over to the #mPED#m or the #mPI#m.

                  Press #fdarkgray SPACE#D to continue.').

  close_window ().
end. (* Experiment Deintegration *)

topic 'Experiment Integration'.
  window ('Experiment Integration',blue,white,white).

  say ('
        EXPERIMENT INTEGRATION - Often referred to as Level
        IV integration and consists of installation and
        assembly of payload elements into Spacelab mounting
        elements, mating the assemblies with certain Spacelab
        subsystems, and performing payload element and
        integrated testing.

              Press #fdarkgray SPACE#D to continue.').

  close_window ().
    end.  (* experiment integration *)

topic 'Experiment/Facility Preintegration'.
  window ('Experiment Facility Preintegration',blue,white,white).

  say ('

        These are activities to be performed at #mKSC#m by the
        Payload Element Developer (#mPED#m) or the Principal
        Investigator (#mPI#m) to prepare the hardware or speciman
        for integration with a carrier and other experiments/
        facilities.

              Press #fdarkgray SPACE#D to continue.').

  close_window ().
end. (* Experiment Facility/Preintegration *)

topic 'FO'.
  window ('FO',blue,white,white).

  say ('

    Functional Objective

          Press #fdarkgray SPACE#D to continue.').

  close_window ().
end. (* FO *)

topic 'GSE'.
```

```
window ('GROUND SUPPORT EQUIPMENT (GSE)',blue,white,white).

say ('

        GROUND SUPPORT EQUIPMENT (GSE) - Non-flight
        equipment at the physical integration site
        required to handle/service/inspect/test/align/
        adjust/repair/modify the flight hardware/software.

                Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* GSE *)

topic 'hardware'.
   window ('Hardware ',blue,white,white).

   say ('

        The total set of space flight equipment which will
        perform the experiment in conjunction with the
        associated software, ground support equipment (#mGSE#m),
        documentation, etc.

                Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* hardware *)

topic 'KCS IV 0018.0'.
   window ('KCS IV 0018.0',blue,white,white).

   say ('
        This document describes the relationship of a Payload
        Mission Manager (#mPMM#m), the Principal Investigator
        (#mPI#m), and Payload Element Developer (#mPED#m) to #mKSC#m
        supporting systems for processing payloads, using the
        Spacelab flight system capabilties and other horizontal
        or "attached" payloads.  It provides you with guidelines,
        information on constraints, and documentation systems.
        This handbook is intended to give you, a potential user --
        Payload Mission Manager, Principal Investigator or Payload
        Element Developer -- information to aid you in achieving
        your goals.

        You should use this document for reference during early
        definition phases to assist you in establishing both
        flight and ground support equipment requirements.  By
        this, you can assure yourself of the capability to verify
        your equipment during the integration process for launch.
        It will also allow proper planning of resources during
        this process and enable you to eliminate unnecessary costs.

                Press #fdarkgray SPACE#d to continue.').
```

```
     close_window ().
end. (* KCS IV 0018.0 *)

topic 'KSC'.
   window ('KSC',blue,white,white).

   say ('

             Kennedy Space Center

         Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* KSC *)

topic 'MPE'.
   window ('Mission-Peculiar Equipment (MPE)',blue,white,white).

   say ('

         Mission-Peculiar Equipment (MPE) is mission unique,
         "make work," interfacing hardware and/or software
         (cables, brackets, structure, etc.) between the
         experiment facilities and the Spacelab and/or Shuttle
         standard accommodations.

         Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* MPE *)

topic 'MPED'.
   window ('Mission-Peculiar Equipment Payload Element Developer (MPED)',
   blue,white,white).

   say ('
         Mission-Peculiar Equipment (MPE) is mission unique,
         "make work," interfacing hardware and/or software
         (cables, brackets, structure, etc.) between the
         experiment facilities and the Spacelab and/or Shuttle
         standard accommodations.

         The MPED is responsible for design, development, and
         delivery of MPE hardware/software to the requirements
         of the #mPMM#m to allow integration of instruments with
         #mSTS#m flight equipment.  This equipment, like the
         instruments, must satisfy the safety and interface
         requirements/constraints of the STS flight and ground
         systems.

         Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* MPED *)
```

```
topic 'O&IA'.
   window ('O&IA',blue,white,white).

   say ('

           Operations and Integration Agreement


                    Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* O&IA *)

topic 'OPS'.
   window ('OPS',blue,white,white).

   say ('

           Oxygen Portable System

                   Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* OPS *)

topic 'payload'.
   window ('PAYLOAD',blue,white,white,4,4,70,14).

   say ('

           PAYLOAD - The total complement of instruments,
           equipment, support hardware/software and
           carried in the Space Shuttle (excluding Orbiter
           basic payload support) to accomplish a given
           objective in space.  It, therefore, includes
           items such as free-flying automated spacecraft,
           individual experiments or instruments, and #mASE#m.

                   Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* payload *)

topic 'payload element'.
   window ('PAYLOAD ELEMENT',blue,white,white).

   say ('

           PAYLOAD ELEMENT - The experiment facilities and
           the support hardware/software which are the
           component parts of the #mpayload#m.

           Press #fdarkgray SPACE#D to continue.').

   close_window ().
```

6

```
end. (* payload element *)

topic 'Payload Element Developer'.
   window ('PAYLOAD ELEMENT DEVELOPER (PED)',blue,white,white).

   say ('
         Payload Element Developer (PED) is a collective
         term that applies to both #mMPED#m and #mEPED#m,
         since experiment instruments, experiment facilities,
         and #mMPE#m are all, in fact, #mpayload element#ms.
         The breakout of MPED and EPED under PED is made here
         only to illustrate characteristics of the interfaces.
         Throughout this document, however, the inclusive term,
         PED, is used and includes both EPEDs and MPEDs.

                Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* PAYLOAD ELEMENT DEVELOPER *)

topic 'Payload Integration'.
   window ('Payload Integration',blue,white,white).

   say ('

         These are the activities where the integrated payload
         is mated with the Orbiter, new interfaces are verified,
         and final payload servicing and closeout are performed.
         These activities may be accomplished in 2 steps:
         utilizing Orbiter simulations with the flight Orbiter.

                Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* Payload Integration *)

topic 'PED'.
   window ('PED',blue,white,white).

   say ('

         #mPayload Element Developer#m

             Press #fdarkgray SPACE#D to continue.').

   close_window ().
   end. (* PED *)

topic 'PI'.
   window ('Principal Investigator (PI)',blue,white,white).

   say ('

      The Principal Investigator is in charge of the conduct of
      the experiment and is responsible for defining the data or
```

other products required/desired from the operation of an
instrument or experiment facility (a payload element) and
for providing scientific support during the physical
integration and flight operation of the equipment. This
may include defining the performance requirements on
equipment to be developed or may only be the definition
of the use of existing equipment. A PI may also be the
Experiment Payload Element Developer (#mEPED#m).

       Press #fdarkgray SPACE#D to continue.').

```
   close_window ().
   end.  (* PI *)

topic 'PMM'.
   window ('PAYLOAD MISSION MANAGER (PMM)',blue,white,white).

   say ('
         PAYLOAD MISSION MANAGER (PMM) - The person
         responsible for integrated payload definition
         and payload element integration, for integrated
         payload flight planning and operations to ensure
         meeting PI requirements, for payload element
         compatibility with themselves and with the #mSTS#m,
         and for verifying that all safety requirements
         have been met.

            Press #fdarkgray SPACE#D to continue.').

   close_window ().
end.  (* PMM *)

topic 'POCC'.
   window ('Payload Operations Control Center (POCC)',blue,white,white).

   say ('

         Central area, located at any of three NASA centers, from
         which payload operations are monitored and controlled.
         The user, in many instances, will have direct command of
         a payload from this control center.

               Press #fdarkgray SPACE#D to continue.').

   close_window ().
end.  (* POCC *)

topic 'requirement'.
   window ('REQUIREMENT',blue,white,white).

   say ('

         REQUIREMENT - A specified mandatory condition which
         must be complied with unless a noncompliance report
         is approved by the Center Commander/ Director.
```

8

```
                    Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* requirement *)

topic 'STS'.
  window ('STS',blue,white,white).

  say ('

        Space Transportation System

           Press #fdarkgray SPACE#D to continue.').

   close_window ().
end. (* STS *)
```

```
(*                              ERD QUESTION 9                              *)
(* ERDQ911.KB is the knowledge base called from the ERDQUEST.KB.           *)
(* It is loaded whenever the user wishes to fill out Question 9,           *)
(* Part 1 Option 1 of the ERD.  The user is guided through a series        *)
(* of questions, requiring either narrative, logic, or selection          *)
(* responses.                                                             *)

topic 'ERD_9_1_1'.

  :q911prev = N.
  :eof = number_to_char (26).
  :q911old is read (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT')).
  if ?q911old <> ?eof
    then q911prev = Y.


  relatedfile = '\PREFEQIP.DAT'.
  relatedtopic = 'Research Equipment (Preflight)'.
  filename = '\ERD911.DAT'.

  window ('Description of Planned Activities',blue,white,white,2,2,70,11

  say ('#e
    Please enter a narrative description of the type of activities
    planned for the preparation of your equipment for integration.
    In a #mrelated answer#m in the SRD, you were asked to describe the
    #fyellow Research Equipment (Preflight)#d.  Please be sure to discus
    equipment referenced in the SRD that must undergo postshipment
    assembly, test, calibration or servicing, or click #mhere#m to
  #s edit', ?relatedtopic,'.  #l #n

        Press the #fyellow RETURN KEY#d to enter the editor,
      #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm

  edit_file (concat (C:\GARDEN\,?CURDIR,'\ERD911.DAT'),yellow,black,red,

  close_window ().

  if ?q911prev = Y
    then
      old_fs = element(?q911old,4)
      and
      old_flr = string_replace (?old_fs,
        'Total Floor Space Required Including Space for GSE:    ','',1)
      and
      old_floorspace = string_replace (?old_flr,' Square Feet','',1)
      and
  read_response ('#e
    Enter the total square feet that will be necessary to
    accomplish your activities.  Include enough area to
    accommodate the #mGSE#m that will be necessary for
    these activities.  If you anticipate having spare units,
    include space for these also.

    Your previous answer was:    ',floorspace,?old_floorspace)
```

```
          else
read_response ('#e
    Enter the total square feet that will be necessary to
    accomplish your activities.  Include enough area to
    accommodate the #mGSE#m that will be necessary for
    these activities.  If you anticipate having spare units,
    include space for these also.#n',floorspace,0).

if ?floorspace = ' ' or ?floorspace = [ ]
   then floorspace = '_____'.

floorspace = concat ('Total Floor Space Required Including Space for
   ?floorspace, ' Square Feet').

table9_1 gets '(X) Experiment/Facility Preintegration'.
table9_1 gets '( ) Experiment/Facility Preparation'.
table9_1 gets '( ) Postmission Requirements'.


table9_1 gets ?floorspace.

if ?q911prev = Y
   then
     old_ch = element (?q911old,5)
     and
     old_ch = string_replace (?old_ch,
     'Ceiling Height Required:   ','',1)
     and
     old_ceiling = string_replace (?old_ch,' ft.','',1)
     and
     read_response ('#e
        Please enter the required ceiling height, in feet.

        Your previous answer was:   ',ceiling,?old_ceiling)
   else
     ceiling_list is ['10','15',OTHER]
     and
     ask ('#e
   What is the required ceiling height, in feet?',ceiling,?ceiling_li:

if ?ceiling = OTHER
   then read_response ('
   Please enter the required ceiling height, in feet.#n',ceiling,0).

if ?ceiling = ' ' or ?ceiling = [ ]
   then ceiling = '_____'.

ceiling = concat ('Ceiling Height Required:   ',?ceiling,' ft.').

table9_1 gets ?ceiling.

if ?q911prev = Y
   then
     old_crane = element(?q911old,6)
     and
```

2

```
        old_crane = string_replace (?old_crane,' ft.','',1)
        and
        old_height = string_copy (?old_crane,55,10)
        and
        crane_yn = string_copy (?old_crane,25,15)
        and
        if ?crane_yn = '(X) YES  ( ) NO'
          then crane_yn = YES
        else
          crane_yn = NO.

if ?q911prev = Y
  then
    ask (['#e
      Is an overhead crane required?

      Your previous answer was: ',?old_crane],crane,?yn)

  else
    ask ('#e
      Is an overhead crane required?',crane,?yn).

if ?crane = YES and ?q911prev = Y
  then read_response ('
Please enter the required hook height, in feet.

  Your previous answer was:  ',hook,?old_height)
else
  if ?crane = YES
    then read_response ('
Please enter the required hook height, in feet.#n',hook,0).

if ?crane = YES
  then if ?hook = ' ' or ?hook = [ ]
    then hook = '_____'.

if ?crane = YES
  then
    crane = concat ('Overhead Crane Required (X) YES  ( ) NO.  Hook Hei
      ?hook,' ft.')
  else
    crane = 'Overhead Crane Required ( ) YES  (X) NO.'.

table9_1 gets ?crane.

if ?q911prev = Y
  then
    old_p120 = element (?q911old,7).

if ?q911prev = Y
  then ask (['#e

  What is the required facility power?  120/208 V, 60 Hz is
  standard.  If you have a requirement for something other
  than the standard, specify OTHER and describe.  Please
```

```
        answer YES to all that apply.

        Will you require #fgray 120 V, 1 o, 60Hz#d?

        Your previous answer was:    #n',?old_p120],p120,?yn)

     else
       ask ('#e

        What is the required facility power?  120/208 V, 60 Hz is
        standard.  If you have a requirement for something other
        than the standard, specify OTHER and describe.  Please
        answer YES to all that apply.

        Will you require #fgray 120 V, 1 o, 60Hz#d?',p120,?yn).

if ?p120 = YES
   then
      power120 = 'Facility Power Required:   (X) 120 V, 1 o, 60 Hz'
   else
      power120 = 'Facility Power Required:   ( ) 120 V, 1 o, 60 Hz'.

table9_1 gets ?power120.

if ?q911prev = Y
   then
      old_p240 = element (?q911old,8).

if ?q911prev = Y
   then
      ask (['#e

     Will you require #fgray 208 V, 3 o, 60 Hz#d?

      Your previous answer was:   #n',?old_p240],p240,?yn)
else
      ask ('
      Will you require #fgray 208 V, 3 o, 60 Hz#d?',p240,?yn).

if ?p240 = YES
   then
      power240 = '                              (X) 240 V, 3 o, 60 Hz'
   else
      power240 = '                              ( ) 240 V, 3 o, 60 Hz'.

table9_1 gets ?power240.

if ?q911prev = Y
   then
      old_othpower = element (?q911old,9)
      and
      old_spec_power = string_copy (?old_othpower,37,80)
      and
      other_yn = string_copy (?old_othpower,27,9)
      and
```

```
        if ?other_yn = '(X) OTHER'
          then other_yn = YES
        else
          other_yn = NO.

   if ?q911prev = Y
     then
        ask (['#e
     Will you require #fgray OTHER#d power types?

      Your previous answer was: #s ',?other_yn],otherpower,?yn)
     else
   ask ('
      Will you require #fgray OTHER#d power types?',otherpower,?yn).

   if ?otherpower = YES
     then if ?q911prev = Y
        then read_response ('
        Please specify these OTHER power needs.

         Your previous answer was:   ',spec_other_power,?old_spec_power)
        else
        read_response ('
        Please specify these OTHER power needs.',spec_other_power).


   if ?otherpower = YES
     then
       powerother = concat ('                              (X) OTHER ',
       ?spec_other_power)
     else
       powerother =            '                          ( ) OTHER '.

   table9_1 gets ?powerother.

   if ?q911prev = Y
     then
        old_gn2 = element (?q911old,10)
        and
        old_gn2 = string_copy (?old_gn2,36,3)
        and
        if ?old_gn2 = 'NO_'
          then old_gn2 = NO.


   if ?q911prev = Y
     then
        ask (['
   OTHER FACILITY SUPPORT:  GN2 and GHe are generally
   available in the facilities at #mKSC#m;  if pressure
   required is greater than 3000 psi, specify.  Other
   gases or liquids can be made available (see #mSE-S-0073#m)
   but must be identified.  The standard environment in the
   laboratory areas is for human comfort only;  if this is
   not adequate, specify the requirements.
```

```
Will you require any facility support for GN2 gases?

Your previous answer was: #s',?old_gn2],GN2,?yn)

else
ask ('#e
OTHER FACILITY SUPPORT:  GN2 and GHe are generally
available in the facilities at #mKSC#m;  if pressure
required is greater than 3000 psi, specify.  Other
gases or liquids can be made available (see #mSE-S-0073#m)
but must be identified.  The standard environment in the
laboratory areas is for human comfort only;  if this is
not adequate, specify the requirements.

Will you require any facility support for GN2 gases?',GN2,?yn).

GN2 = concat ('Other Facility Support:  Gases    __',?GN2,'__   GN2').

table9_1 gets ?GN2.

if ?q911prev = Y
  then
    old_ghe = element (?q911old,11)
    and
    old_ghe = string_copy (?old_ghe,36,3)
    and
    if ?old_ghe = 'NO_'
      then old_ghe = NO.


if ?q911prev = Y
  then
    ask (['

Will you require any facility support for GHe gases?

Your previous answer was: #s',?old_ghe],GHe,?yn)
else
ask ('#e
Will you require any facility support for GHe gases?',GHe,?yn).

GHe = concat ('                                        __',?GHe,'__   GHe').

table9_1 gets ?GHe.

if ?q911prev = Y
  then
    old_other = element (?q911old,12)
    and
    old_other = string_copy (?old_other,36,3)
    and
    if ?old_other = 'NO_'
      then old_other = NO.

if ?q911prev = Y
```

6

C-2

```
       then
      ask ([ '
Will you require any facility support for other gases?

Your previous answer was:   #s',?old_other],gasother,?yn)
else
ask ('#e
Will you require any facility support for other gases?',gasother,?yn)

if ?q911prev = Y
   then
      if ?old_other = YES and ?gasother = NO
         then
            ask ('
            Your previous response was YES and your current
            response was NO.  Please confirm that you have
            entered the correct response.

            Will you require any facility support for other gases?',
            gasother,?yn).

if ?gasother = YES
   then
window ('Other Facility Support (Gases)',blue,white,white,2,2,70,6)
and
say ('#e
   Please specify the type along with any nonstandard requirements
   of the gas.

         Press the #fyellow RETURN KEY#d to enter the editor,
      #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confir
and
edit_file (concat (C:\GARDEN\,?CURDIR,'\OTHERGAS.DAT'),yellow,black,r
and
close_window ().

if ?q911prev = Y
   then
      if ?old_other = YES and ?gasother = NO
         then
            dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\OTHERGAS.DAT'))).

gasother = concat ('                                        __',?gasother,'_

table9_1 gets ?gasother.

if ?q911prev = Y
   then
      old_liquid = element (?q911old,13)
      and
      old_liquid = string_copy (?old_liquid,36,3)
      and
      if ?old_liquid = 'NO_'
         then old_liquid = NO.
```

```
if ?q911prev = Y
  then
    ask ([ '#e

Will you require any facility support for liquids?

Your previous answer was:   #s',?old_liquid],liquids,?yn)
else
ask ('#e
Will you require any facility support for liquids?',liquids,?yn).

if ?q911prev = Y
  then
    if ?old_liquid = YES and ?liquids = NO
      then
        ask ('
        Your previous response was YES and your current
        response was NO.  Please confirm that you have
        entered the correct response.

        Will you require any facility support for liquids?',
        liquids,?yn).

if ?liquids = YES
  then
window ('Other Facility Support (Liquids)',blue,white,white,2,2,70,6)
and
say ('#e
    Please specify the type along with any nonstandard requirements
    for all liquids.

        Press the #fyellow RETURN KEY#d to enter the editor,
        #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm
and
edit_file (concat (C:\GARDEN\,?CURDIR,'\LIQUIDS.DAT'),yellow,black,red
and
close_window ().

if ?q911prev = Y
  then
    if ?old_liquid = YES and ?liquids = NO
      then
        dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\LIQUIDS.DAT'))).

liquids = concat ('                          Liquids*          __',?liquids,'__')

table9_1 gets ?liquids.

environs is [STANDARD,OTHER].

if ?q911prev = Y
  then
    old_env = element (?q911old,14)
    and
```

```
             old_env = string_copy (?old_env,16,1)
             and
             if ?old_env = X
                then old_env = STANDARD
                else old_env = OTHER.


if ?q911prev = Y
   then
      ask (['#e
   The standard environment in the laboratory areas is for
   human comfort only;  if this is not adequate, specify
   the requirment.

   Your previous answer was: #s ',?old_env],envir,?environs)

      else
       ask ('#e
   The standard environment in the laboratory areas is for
   human comfort only;  if this is not adequate, specify
   the requirment.',envir,?environs).

if ?q911prev = Y
   then
      if ?old_env = OTHER and ?envir = STANDARD
         then
            ask ('
         Your previous response was OTHER and your current
         response was STANDARD.  Please confirm that you have
         entered the correct response.

         Please specify the environment required.',
         envir,?environs).


if ?envir = OTHER
   then
window ('Other Environment Requirements',blue,white,white,2,2,70,6)
and
say ('#e
   Please specify the nonstandard environment requirements, in
   narrative form.

          Press the #fyellow RETURN KEY#d to enter the editor,
       #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm
and
edit_file (concat (C:\GARDEN\,?CURDIR,'\NSENVIRO.DAT'),yellow,black,re
and
close_window ().

if ?q911prev = Y
   then
      if ?old_env = OTHER and ?envir = STANDARD
         then
            dos (ERASE (concat (C:\GARDEN\,?CURDIR,'\NSENVIRO.DAT'))).
```

```
if ?envir = STANDARD
  then
  envir = 'Environment:    (X) Standard       ( ) Other*'
  else
  envir = 'Environment:    ( ) Standard       (X) Other*'.

table9_1 gets ?envir.

if ?q911prev = Y
  then
    old_haz = element (?q911old,15)
    and
    old_haz = string_copy (?old_haz,26,1)
    and
    if ?old_haz = X
      then old_haz = YES
      else old_haz = NO.


if ?q911prev = Y
  then ask (['#e

Do your planned activities include hazardous operations?

Your previous answer was:   #s',?old_haz],hazop,?yn)
else
ask ('#e
Do your planned activities include hazardous operations?',hazop,?yn).

if ?hazop = YES
  then hazop = 'Hazardous Operations:    (X) Yes      ( ) No'
else
  hazop =          'Hazardous Operations:    ( ) Yes      (X) No'.

table9_1 gets ?hazop.

if ?q911prev = Y
  then
    old_setup = element (?q911old,16)
    and
    old_setup_days = string_replace (?old_setup,
    'Total Anticipated Use Time:     ','',1)
    and
    old_setup_days = string_replace (?old_setup_days,' Days','',1).

if ?q911prev = Y
  then
  read_response ('#e
Specify the time required (in days) to move in, set up your
equipment, and perform your planned activities.

Your previous answer was:   ',setup,?old_setup_days)
  else
read_response ('#e
```

10

```
Specify the time required (in days) to move in, set up your
equipment, and perform your planned activities.',setup,0).

if ?setup = ' ' or ?setup = [ ]
   then setup = '_____'.

setup = concat ('Total Anticipated Use Time:    ',?setup,' Days').

table9_1 gets ?setup.

window ('Other Facility Support Description',blue,white,white,2,2,70,6

load ('JA713A.hkb').

say ('#e
   Please identify any support that you may require that
   would prevent your utilizing a standard-type laboratory
   or that would require augmentation of a standard
   laboratory capability.  Requirements for life science
   facilities should be included here by referencing PI/PED
   provided forms as described in #mJA-713 Section 4#m, MSFC
   Payload Mission Manager Guidelines for use of Life Sciences
   Facilities.

      Press the #fyellow RETURN KEY#d to enter the editor,
      #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm

edit_file (concat (C:\GARDEN\,?CURDIR,'\OFSDESC.DAT'),yellow,black,red

close ('JA713A.hkb').
remove_topic ('JA-713 Section 4').
close_window ().

new_file  (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT')).
write (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT'),?table9_1,#n).
close (concat (C:\GARDEN\,?CURDIR,'\ERDQ911.DAT')).
reset (table9_1).

topic 'related answer'.
   related_answer is read(concat(C:\GARDEN\,?CURDIR,?RELATEDFILE)).
   window ('Related Topic',blue,white,white,2,2,76,14).
   say ('
      This is your answer for the: #fyellow #t',
                  ?relatedtopic,'#d #n #n',
?related_answer,'#n #n
                  Press #fyellow SPACE #d to continue.').
   window ('Use this answer?',yellow,blue,red,2,12,74,6).
   ask ('
Would you like to incorporate this answer into your current response?'
incorporate,?yn).
   if ?incorporate = YES
     then write (concat(C:\GARDEN\,?CURDIR,?FILENAME),?related_answer).
   close_window ().
   close_window ().
   close (concat(C:\GARDEN\,?CURDIR,?FILENAME)).
```

11

```
end.   (* related answer *)

topic 'here'.
   window (?relatedtopic,blue,white,white,2,2,70,11).
   say ('
        Please make any corrections necessary to the
             #s ',?relatedtopic,'#n #1

     Press the #fyellow RETURN KEY#d to enter the editor,
    #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm sav

   edit_file (concat(C:\GARDEN\,?CURDIR,?RELATEDFILE),yellow,black,red,5,
   12).
   close_window ().
   close (concat(C:\GARDEN\,?CURDIR,?RELATEDFILE)).

end.   (* here *)


end. (* ERD_9_1_1 *)
```

```
(*                          ERD QUESTION 9                             *)
(* ERDQ92.KB is the knowledge base called from the ERDQUEST.KB.        *)
(* It is loaded whenever the user wishes to fill out Question 9,       *)
(* Part 2 of the ERD.  The user is guided through a series             *)
(* of questions, requiring narrative responses.                       *)

topic 'ERD_9_2_1'.
  close_window ().

  window ('Description of Special Alignment, etc.',blue,white,white,2,2,

  say ('#e
   Please enter a narrative description of special alignment,
   calibration, servicing, or performance verification and
   estimated time to perform.  Describe any activities that
   must be performed on the equipment either during or after
   its integration with the carrier or Orbiter and an
   estimate of the time that will be required to perform
   the activities.  If it must be performed periodically,
   also identify the period, such as once every month.

        Press the #fyellow RETURN KEY#d to enter the editor,
        #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm

  write ('con:','#e

        Press the #fyellow RETURN KEY#d to enter the editor,
        #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm

  edit_file  (concat (C:\GARDEN\,?CURDIR,'\ERD921.DAT'),yellow,black,red

  close_window ().

  window ('Identification of Any Constraints',blue,white,white,2,2,70,6)

  say ('#e
    Please enter a narrative identification of any constraints
    on experiment/facility operation during test.

        Press the #fyellow RETURN KEY#d to enter the editor,
        #fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm

  edit_file (concat (C:\GARDEN\,?CURDIR,'\ERD922.DAT'),yellow,black,red,

  close_window ().

  window ('Description of Time-Critical Operations',blue,white,white,2,2

  say ('#e
    Please enter a narrative description of any time-critical
    operations, such as last speciment loading or final
    servicing of a cryogenic dewar.  Include the time constraints
    relative to launch or a specific operation of the experiment/
    facility.
```

Press the #fyellow RETURN KEY#d to enter the editor,
#fyellow ESC#d to leave editor, and #fyellow RETURN#d to confirm

```
edit_file (concat (C:\GARDEN\,?CURDIR,'\ERD923.DAT'),yellow,black,red,

close_window ().
```

end. (* ERD_9_2_1 *)

```
(* SRDREF.KB          This program lists the cross references      *
(*                      for the Science Requirements Document.     *


do (soutline).
new_kb ('nasa.ckb').

topic soutline.
      say ('

      The Science Requirements Document has sections that
      reference information contained in other sections of
      the SRD as well as other documents.  This outline is
      used to display those references.

         The Outline for the Science Requirements Document:

                  1. #mIntroduction/Summary#m

                  2. #mBackground#m

                  3. #mJustification for Conducting the Experiment in Space

                  4. #mExperiment Details#m




                  5. #mExperiment Requirements#m

                  6. #mPrincipal Investigator''s Requirements#m

                  7. Other Requirements

                      Press #fyellow SPACE#d to continue.').

end. (* soutline*)


(*==============================Threaded topics===================*)

topic 'Introduction/Summary'.
      window ('Introduction/Summary',blue,white,white,,,,12).
      say ('
      Only the highlighted sections are referenced further.

      #m1.1 Description of Experiment#m

      #m1.2 Scientific Knowledge to be Gained#m

      1.3 Value of Knowledge to Scientific Field

      #m1.4 Justification of the Need for Space Environment#m
```

```
                    Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*Introduction/Summary*)

topic 'Background'.
        window ('Background',blue, white,white,2,5,70,17).
        say ('
     Only the highlighted sections are referenced further.

   2.1 Description of Scientific Field to which the Experiment Belongs

   2.2 Current Application for Research in the Field

   #m2.3 Brief Historical Account of Prior Research#m

   #m2.4 Current Research#m

   2.5 Relationship of Proposed Experiment to Scientific Field

   #m2.6 Anticipated Advance in State of the Art#m

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*Background*)

topic 'Justification for Conducting the Experiment in Space'.
        window ('Justification for Conducting the Experiment in Space',blu
        white,white,2,4,70,18).
        say ('
Each one of these sections:

        3.1 Limitations of Ground-Based Testing
        3.2 Limitations of Drop Towers
        3.3 Limitations of Testing in Aircraft
        3.4 Need for Accommodations in the Shuttle
        3.5 Limitations of Mathematical Modeling
        3.6 Limitations of other Modeling Approaches

        are referenced further in:

        SRD Section:

        1.4 Justification of the Need for Space Environment

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*Justification for Conducting the Experiment in Space*)

topic 'Experiment Details'.
        window ('Experiment Details',blue,white,white,,,74,18).
        say ('
     Only the highlighted sections are referenced further.

   #m4.1 Experiment Procedures to be Used#m
```

#m4.2 Measurements Required#m

#m4.3 Test Plan Including Ground Characteristics of Flight Hardware#m

#m4.4 Specific Analysis Required#m

#m4.5 Preflight Experiment Planned#m

#m4.6 Post Flight Data Handling and Analysis#m

4.7 Mathematical Models Used

#m4.8 Application of Results#m

are referenced in:
        SRD Section
        1.1 Description of Experiment
        ERD Section
        1.1 Functional Objectives

and the highlighted sections are referenced further.

                Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Experiment Details*)

topic 'Experiment Requirements'.
        window ('Experiment Requirements',blue,white,white,2,5,70,18).
        say ('
    Only the highlight sections are referenced further.

    #m5.1 Experiment Sample Requirements#m

    #m5.2 Atmospheric Requirements#m   .

    #m5.3 Temperature Control and Measurement#m

    #m5.4 Vibration Control and Measurement#m

    #m5.5 Test Matrix#m

    #m5.6 Imaging Requirements#m

    #m5.7 Electromagnetic Limitations#m

    #m5.8 Astronaut Involvement#m

    #m5.9 Data Requirements#m

```
        #m5.10 Telepresence, Telerobotics#m

    are referenced in:
        SRD Section
        1.1 Description of Experiment
        ERD Section
        1.1 Functional Objectives

    and the highlighted sections are referenced further.

                Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Experiment Requirements*)

topic 'Principal Investigator''s Requirements'.
        window ('Principal Investigator''s Requirements',blue,white,white,
        15).
        say ('
    Only the highlighted sections are referenced further.

    #m6.1 Research Equipment#m

    #m6.2 Apparatus Design Assistance#m

    6.3 Consultation

    6.4 Grant, Contract

    #m6.5 Services#m

                Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Principal Investigator's Requirements*)


(*=========================the topics have subtopics ============*)

topic '1.1 Description of experiment'.
        window ('1.1 Description of experiment',blue,white,white,,,,13).
        say ('
    This section is referenced further in:

    SRD Sections
    4.0 Experiment Details
        (breaks area down into more specific details)

    5.0 Experiment Requirements
        (describes requirements in more details)

    MSAD Management Plan
    E.2.5.1 Missions
    E.2.5.2 System(s) and Subsystems


    JA-003
```

4

2.1 General (Flight Equipment Design and Fabrication)

    JA-1303
    2.1 General (Flight Equipment Design and Fabrication)

            Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*1.1 Description of experiment*)

topic '1.2 Scientific knowledge to be gained'.
        window ('1.2 Scientific knowledge to be gained',blue,white,white).
        say ('

    This section is referenced further in:

        SRD Section
        2.6 Anticipated Advance in State of the Art

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*1.2 Scientific knowledge to be gained*)

topic '1.4 Justification of the need for space environment'.
        window ('1.4 Justification of the need for space environment',blue
        white).
        say ('

    This section is referenced further in:

        SRD Section
        3.0 Justification for Conducting the Experiment in Space

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*1.4 Justification of the need for space environment*)

topic '2.3 Brief historical account of prior research'.
        window ('2.3 Brief historical account of prior research',blue,whit
        white).
        say ('

    This section is referenced further in:

        ERD Section
        11.1 PED/PI Defined Training
            (Science Background and Experiment Objectives)

                        Press #fyellow SPACE#d to continue.   ').
        close_window ().
end. (*2.3 Brief historical account of prior research*)

topic '2.4 Current research'.

```
        window ('2.4 Current Research',blue,white,white).
        say ('

This section is referenced further in:

    MSAD Management Plan
    E.2.4 Related Studies and Activities


                    Press #fyellow SPACE#d to continue.        ').
        close_window ().
end.  (*2.4 Current research*)

topic '2.6 Anticipated advance in state of the art'.
        window ('2.6 Anticipated advance in state of the art',blue,white,w
        say ('

This section is referenced further in:

    SRD Sections
    1.2 Scientific Knowledge to be Gained

    4.8 Application of Results

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*2.6 Anticipated advance in state of the art*)

topic '4.1 Experiment procedures to be used'.
        window ('4.1 Experiment procedures to be used',blue,white,white,2,
        16).
        say ('
    This section is referenced further in:

    SRD Sections
    5.1 Experiment Sample Requirements  (number, materials)

    5.5 Test Matrix (number of durations required)

    ERD Sections

    9.2.2 Experiment/Facility Preparation

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*4.1 Experiment procedures to be used*)

topic '4.2 Measurements required'.
        window ('4.2 Measurements required',blue, white,white,,,,18).
        say ('
    This section is referenced further in:

    SRD Sections
    5.1 Experiment Sample Requirements
```

5.2 Atmospheric Requirements

          5.3 Temperature Control and Measurement

          5.4 Vibration Control and Measurement

                              Press #fyellow SPACE#d to continue.').
          close_window ().
end. (*4.2 Measurements required*)

topic '4.3 Test plan including ground characteristics of flight hardware
          window ('4.3 Test plan including ground character of hardware',blu
          white,white,,,,16).
          say ('
     This section is referenced further in:

          MSAD Management Plan
          E.2.5.4 Flight Hardware Classification

          JA-003
          2.1 General (Flight Equipment Design and Fabrication)

          JA-1303
          2.1 General (Flight Equipment Design and Fabrication)

                              Press #fyellow SPACE#d to continue.   ').
          close_window ().
end. (*4.3 Test plan including ground character of hardware*)

topic '4.4 Specific analysis required'.
          window ('4.4 Specific analysis required',blue,white,white,,,,12).
          say ('

     This section is referenced further in:

          SRD Sections

          5.1 Experiment Sample Requirements

                    Press #fyellow SPACE#d to continue.').
          close_window ().
end. (*4.4 Specific analysis required*)

topic '4.5 Preflight experiment planned'.
          window ('4.5 Preflight experiment planned',blue,white,white,,,,13)
          say ('
     This section is referenced further in:

          SRD Sections
          6.1 Research Equipment

          ERD Sections
          9.1.1 Experiment/Facility Preintegration
               (Ground Integration)

                              7

```
                9.2.1 Experiment/Facility Preintegration
                       (Developer Requirements)

                JA-003
                6.1.2.3 Payload Integrated Testing

                JA-1303
                8.1 Payload Prelaunch Handling

                              Press #fyellow SPACE#d to continue.').
            close_window ().
end. (*4.5 Preflight experiment planned*)

topic '4.6 Post flight data handling and analysis'.
        window ('4.6 Post flight data handling and analysis',blue,white,wh
        say ('
      This section is referenced further in:

        SRD Sections
        6.1 Research Equipment

        ERD Sections
        9.2.4 Experiment Late-Access Design Requirements

        9.2.5 Postmission Requirements

        9.2.6 Postmission Early-Access Requirements




        MSAD Management Plan
        E.2.5.8 Analysis of Mission Results

        JA-003
        9.1 Post-Flight Data Reduction, Analysis, and Reporting

        JA-1303
        9.1 Post-Flight Data Reduction, Analysis, and Reporting

                              Press #fyellow SPACE#d to continue.').
            close_window ().
end. (*4.6 Post flight data handling and analysis*)

topic '4.8 Application of results'.
        window ('4.8 Application of results',blue,white,white,,,,12).
        say ('

    This section is referenced further in:

        SRD Sections
        1.2 Scientific Knowledge to be Gained

        2.6 Anticipated Advance in the State of the Art
```

```
                              Press #fyellow SPACE#d to continue').
        close_window ().
end.  (*4.8 Application of results*)


topic '5.1 Experiment sample requirements'.
        window ('5.1 Experiment sample requirements',blue,white,white,,,,1
        say ('
     This section is referenced further in:

        SRD Sections
        4.1 Experiment Procedures to be Used

        4.2 Measurements Required

        4.4 Specific Analysis Required

        ERD Sections
        4.0 Orbital Requirements and Constraints

        5.0 Electrical Requirements

                         Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*5.1 Experiment sample requirements*)


topic '5.2 Atmospheric requirements'.
        window ('5.2 Atmospheric requirements',blue,white,white,,,,16).
        say ('
     This section is referenced further in:

        SRD Sections
        4.2 Measurements Required

        ERD Sections
        6.2 Fluid Requirements

        6.3 Ascent/Decent Thermal Control Requirements

        12.1 Flight Enviromental Limits

                 Press #fyellow SPACE#d to continue. ').
        close_window ().
end.  (*5.2 Atmospheric requirements*)


topic '5.3 Temperature control and measurement'.
        window ('5.3 Temperature control and measurement',blue,white,white
        say ('
     This section is referenced further in:

        SRD Sections
        4.2 Measurements Required

        ERD Sections
        6.1 Heat Transfer Characteristics
```

6.3 Ascent/Decent Thermal Control Requirements

                              Press #fyellow SPACE#d to continue.').
          close_window ().
end. (*5.3 Temperature control and measurement*)

topic '5.4 Vibration control and measurement'.
          window ('5.4 Vibration control and measurement',blue,white,white,,
          say ('
     This section is referenced further in:

          SRD Sections
          4.2 Measurements Required

          ERD Sections
          3.2.2 Stability Requirements

          3.4 Experiment On-Orbit Acceleration and Vibration Limits

                              Press #fyellow SPACE#d to continue.').
          close_window ().
end. (*5.4 Vibration control and measurement*)

topic '5.5 Test matrix'.
          window ('5.5 Test matrix',blue,white,white,,,,14).
          say ('
     This section is referenced further in:

          SRD Sections
          4.1 Experiment Procedures to be Used

          ERD Sections
          4.0 Orbital Requirements and Constraints

          7.0 Data Systems Requirements

                    Press #fyellow SPACE#d to continue.').
          close_window ().
end. (*5.5 Test matrix*)

topic '5.6 Imaging requirements'.
          window ('5.6 Imaging requirements',blue,white,white,2,5,70,16).
          say ('
     This section is referenced further in:

          SRD Section
          6.5 Services

          ERD Sections
          3.0 Pointing/Stabilization and Alignment

          4.0 Orbital Requirements and Constraints

          5.0 Electrical Requirements

                                    10

```
                7.0 Data Systems Requirements

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.6 Imaging requirements*)

topic '5.7 Electromagnetic limitations'.
        window ('5.7 Electromagnetic limit',blue,white,white,2,5,70,14).
        say ('
    This section is referenced further in:

        ERD Section
        5.0 Electrical Requirements

        JA-003
        2.3.4 Electromagnetic Interference (EMI)

        JA-1303
        2.3.4 Electromagnetic Interference (EMI)

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.7 Electromagnetic limit*)

topic '5.8 Astronaut involvement'.
        window ('5.8 Astronaut involvement',blue,white,white,2,5,70,12).
        say ('
    This section is referenced further in:

        ERD Sections

        11.0 Training Objectives

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.8 Astronaut involvement*)

topic '5.9 Data requirements'.
        window ('5.9 Data requirements',blue,white,white).
        say ('This section is referenced further in:

        SRD Sections
        6.5 Services (film developing, software)

        ERD Sections
        7.0 Data Systems Requirements

        8.0 Flight Software Requirements

        10.0 Mission Operations Support

        JA-003
        2.2.2  Data and Analysis

        JA-1303
```

```
                    2.2.3 Data and Analysis

                            Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*5.9 Data requirements*)


topic '6.1 Research equipment'.
        window ('6.1 Research equipment',blue,white,white,2,5,70,13).
        say ('This section is referenced further in:

        SRD Sections
        4.5 Preflight Experiment Planned

        4.6 Post Flight Data Handling and Analysis

        ERD Sections
        9.1.1 Experiment/Facility Preintegration

        9.2.4 Experiment Late-Access Design Requirements

        9.2.5 Postmission Requirements

        9.2.6 Postmission Early-Access Requirements

                            Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*6.1 Research equipment*)


topic '6.2 Apparatus design assistance'.
        window ('6.2 Apparatus design assistance',blue,white,white).
        say ('  This section is referenced further in:

        ERD Sections
        1.2 Equipment Identification

        2.0 Structural/Mechanical

        6.2 Fluid Requirements

        9.2.2 Experiment/Facility Preparation

                            Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*6.2 Apparatus design assistance*)


topic '6.5 Services'.
        window ('6.5 Services',blue,white,white).
        say ('This section is referenced further in:

        SRD Sections
        5.6 Imaging Requirements

        5.9 Data Requirements

        ERD Sections
```

```
                7.0 Data Systems Requirements

                8.0 Flight Software Requirements


                            Press #fyellow SPACE#d to continue.').
        close_window ().
   end. (*6.5 Services*)


   (*========================= end subtopics==================*)




   topic '5.9 Data requirements'.
        window ('5.9 Data requirements',blue,white,white,,,,12).
        say ('
      This section is referenced further in:

        SRD Sections
        1.1 Description of Experiment

        6.5 Services (film developing, software)

        ERD Sections
        1.1 Functional Objectives (Data)

        7.0 Data Systems Requirements

        8.0 Flight Software Requirements

        10.0 Mission Operations Support

        JA-003
        2.2.2  Data and Analysis

        JA-1303
        2.2.3 Data and Analysis

                            Press #fyellow SPACE#d to continue.').
        close_window ().
   end. (*5.9 Data requirements*)

   topic '5.10 Telepresence, telerobotics'.
        window ('5.10 Telepresence, telerobotics',blue,white,white).
        say ('
      This section is referenced further in:

        SRD Section
        1.1 Description of Experiment

        ERD Section
        1.1 Functional Objectives

                    Press #fyellow SPACE#d to continue.').
```

```
      close_window ().
end.  (*5.10 Telepresence, telerobotics*)

topic '6.1 Research equipment'.
      window ('6.1 Research equipment',blue,white,white,2,5,70,18).
      say ('
   This section is referenced further in:

      SRD Sections
      4.5 Preflight Experiment Planned

      4.6 Post Flight Data Handling and Analysis

      ERD Sections
      9.1.1 Experiment/Facility Preintegration

      9.2.4 Experiment Late-Access Design Requirements

      9.2.5 Postmission Requirements

      9.2.6 Postmission Early-Access Requirements

                        Press #fyellow SPACE#d to continue.').
      close_window ().
end.  (*6.1 Research equipment*)

topic '6.2 Apparatus design assistance'.
      window ('6.2 Apparatus design assistance',blue,white,white,,,,13).
      say ('
   This section is referenced further in:

      ERD Sections
      1.2 Equipment Identification

      2.0 Structural/Mechanical

      6.2 Fluid Requirements

      9.2.2 Experiment/Facility Preparation

                        Press #fyellow SPACE#d to continue.').
      close_window ().
end.  (*6.2 Apparatus design assistance*)

topic '6.5 Services'.
      window ('6.5 Services',blue,white,white,,,,14).
      say ('
   This section is referenced further in:

      SRD Sections
      5.6 Imaging Requirements

      5.9 Data Requirements

      ERD Sections
```

7.0 Data Systems Requirements

8.0 Flight Software Requirements

                            Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*6.5 Services*)

(*======================= end subtopics==================*)

.

```
(*ERDREF.KB lists the references to the Experiment Requirements Document
(*The JA-447 lists IIA, IPRD, and O&IA as documents that this informatio
will also be used in.*)

do (outline).
new_kb ('nasa.ckb').

topic outline.
     say ('
The Experiment Requirements Document has sections that reference
information contained in other sections of the ERD as well as other
documents.  This outline is used to display those references.

        The Outline for the Experiment Requirements Document:

        1 #mFunctional Objectives & Equipment Identification#m

        2 #mStructural/Mechanical#m

        3 #mPointing/Stabilization and Alignment#m

        4 #mOrbital Requirements and Constraints#m

        5 #mElectrical Requirements#m

        6 #mThermal Control/Fluid Requirements#m


        7 #mData System Requirements#m

        8 #mFlight Software Requirements#m

        9 #mPhysical Integration#m

       10 #mMission Operations Support#m

       11 #mTraining Objectives#m

       12 #mEnvironmental Contamination Data Requirements#m

       13 Appendix (Abbrevations and Acronyms)

           Press #fyellow SPACE #d to Return to Main Menu').


(*=============================threadedtopics==================*)

topic 'Functional Objectives & Equipment Identification'.
     window ('Functional Objectives & Equipment Identification',blue,wh
     white).
       say ('
Only the highlighted sections are referenced further.
```

#m1.1 Functional Objectives#m

#m1.2 Equipment Identification#m

#m1.3 Operational Function Flows#m

                         Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Functional Objectives*)

topic 'Structural/Mechanical'.
        window ('Structural/Mechanical',blue,white,white).

        say('
        This section is referenced further in:

   SRD Section
     6.2 Apparatus Design Assistance

   MSAD Management Plan
     E2.5.2 System(s) and Subsystems
     E2.5.4 Flight Hardware Classification

   JA-003
     2.2 Mechanical, Structural, and Thermal

   JA-1303
     2.2 Mechanical, Structural, and Thermal

                         Press #fyellow SPACE#d to continue.').
        close_window ().
end.   (*Structural/Mechanical*)

topic 'Pointing/Stabilization and Alignment'.
        window ('Pointing/Stabilization and Alignment',blue,white,
        white).

        say('
     Each of these sections

     3.1 Requirements Description
     #m3.2 Pointing/Stabilization and Field-Of-View Requirements#m
     #m3.3 Experiment Pointing and FOV Capabilities#m
     #m3.4 Experiment On-Orbit Acceleration and Vibration Limits#m
     #m3.5 Experiment Alignment and Coalignment Requirements#m
     are referenced in:

     SRD Section
       5.6 Imaging Requirements

     and the highlighted sections are referenced further.

```
                         Press #fyellow SPACE#d to continue.').
          close_window ().
end. (*Pointing/Stabilization*)

topic 'Orbital Requirements and Constraints'.
       window ('Requirements and Constraints',blue,white,white,,,,14).
       say('
       This section is referenced further in:

       SRD Sections
          5.1 Experiment Sample Requirements
          5.5 Test Matrix
          5.6 Imaging Requirements

       further references are:

          #mViewing Requirements and Constraints#m
          #mVehicle Motion and g-Level Limits#m

                  Press #fyellow SPACE#d to continue.').
          close_window ().
end. (*Orbital Requirements*)

topic 'Electrical Requirements'.
       window ('Electrical Requirements',blue,white,white).
       say ('
       This section is referenced further in:

       SRD Sections
          5.1 Experiment Sample Requirements
          5.6 Imaging Requirements
          5.7 Electromagnetic Limitations

       MSAD Management Plan
          E2.5.6 Logistics

       JA-003
          2.3 Electrical, Data, and Communications

       JA-1303
          2.3 Electrical, Data, and Communications

                        Press #fyellow SPACE#d to continue').
          close_window ().
end. (*Electrical Requirement*)

topic 'Thermal Control/Fluid Requirements'.
   window ('Thermal Control/Fluid Requirements',blue,white,white).

   say ('
      The highlighted sections are referenced further.

         #m6.1 Heat Transfer Characteristics#m
```

```
        #m6.2 Fluid Requirements#m

        #m6.3 Ascent/Decent Thermal Control Requirements#m


                          Press #fyellow SPACE#d to continue.').
           close_window ().
 end. (*Thermal Control*)

 topic 'Data System Requirements'.
   window ('Data System Requirements',blue,white,white).
   say ('
      Each of these sections

         #m7.1 Payload Element to CDMS Interfaces#m
         #m7.2 Caution and Warning#m
         #m7.3 Error Messages Documentation#m

         are referenced in:

         ERD Sections
         9.2.3 Experiment User Room Requirements
         10.0 Mission Oprations Support
         11.5 Training Participation

         SRD Sections
         5.5 Test Matrix
         5.6 Imaging Requirements
         5.9 Data Requirements
         6.5 Services

         JA-003
         2.5 Failure Analysis
         8.4 Mission Data Processing

         JA-1303
         2.5 Failure Analysis
         8.4 Mission Data Processing

         and the highlighted sections are referenced further.

                          Press #fyellow SPACE#d to continue.').
           close_window ().
 end. (*Data System*)

 topic 'Flight Software Requirements'.
   window ('Flight Software Requirements',blue,white,white,,,,12).

   say('
      This section is referenced further in:

         ERD Section
         1.3 Operatonal Function Flows

         SRD Sections
```

```
      5.9 Data Requirements
      6.5 Services

      MDC G6854


      MDC G6862

      JA-003
      4.0 Software
      6.3 Software Verification

      JA-1303
      4.0 Software
      6.3 Software Verification

            Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*Flight Software Requirements*)

topic 'Physical Integration'.
   window ('Physical Integration',blue,white,white).
   say ('
   Each of these sections

   #m9.1 Ground Integration Processing Flow and Definitions#m
   #m9.2 Experiment/Facility Developer Requirements Definition#m
   #mSolids, Fluids, and Gases, Resource Requirements#m

   are referenced in:

   SRD Sections
   6.1 Research Equipment
   6.5 Services

   KCS IV 0018.0

   MSAD Management Plan
   E2.5.5 Facilities
   E2.5.6 Logistics

   JA-003
   2.1 General (Flight Equipment Design and Fabrication)
   3.0 Ground Support Equipment
   5.0 Safety, Reliability, and Quality Assurance
   6.0 Verification
   7.0 Preparation and Delivery

   JA-1303
   2.1 General (Flight Equipment Design and Fabrication)
   3.0 Ground Support Equipment
   5.0 Safety, Reliability, and Quality Assurance
   6.0 Verification
   7.0 Preparation and Delivery
```

the highlighted sections are referenced further.

             Press #fyellow SPACE#d to continue.').
  close_window ().
end. (*Physical Integration*)

topic 'Mission Operations Support'.
  window ('Mission Operations Support',blue,white,white).
  say('
  Each of these sections

  #m10.1 POCC Requirements#m
  #m10.2 Spaclab Data Processing Facility and Other Requirements#m

  are referenced in:

  ERD Sections
  7.0 Data System Requirements
  11.3 PMM Defined Training

  SRD Section
  5.9 Data Requirements

  SL-PA-210

  MSAD Management Plan
  E2.5.6 Logistics

  JA-346

  JA-1303
  8.0 Operations Support

  the highlighted section is referenced further.

             Press #fyellow SPACE#d to continue.').
  close_window ().
end. (*Mission Operations*)

topic 'Training Objectives'.
  window ('Training Objectives',blue,white,white).
  say ('
    Each of these sections

    #m11.1 PED/PI Defined Training#m
    #m11.2 PMM and PED/PI Jointly Defined Training#m
    #m11.3 PMM Defined Training#M
    11.4 Training Simulators
    #m11.5 Training Participation#m

    are referenced in:

```
        ERD Section
        1.1 Functional Objectives

        SRD Section
        5.8 Astronaut Involvement

        JA-003
        8.2 Flight Operations/Training

        JA-1303
        8.2 Flight Operations/Training

        and the highlighted sections are referenced further.

               Press #fyellow SPACE#d to continue.').
    close_window ().
end. (*Training Objectives*)

topic 'Environmental Contamination Data Requirements'.
    window ('Environmental Contamination Data Requirements',blue,white,
        white).
    say ('
        Each of these sections

        #m12.1 Flight Environment Limits#m
        12.2 On-Orbit External Contamination Control Sensitivity
        12.3 External Contamination Sources

        are referenced in:

        MSAD Management Plan
        E2.5.9 Analysis of Safety Issues

        JA-003
        2.1.5 Contamination and Cleanliness

        JA-1303
        2.1.5 Contamination and Cleanliness

        and the highlighted sections are referenced further.

               Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Environment Contamination*)

(*===================the topics have threaded subtopics===============

topic '1.1 Functional Objectives'.

    window ('1.1 Functional Objectives', blue, white, white,,,,15).
    say ('
        This section is referenced further in:

        ERD Sections
        11.1 PED/PI Defined Training
```

```
       11.2 PMM and PED/PI Jointly Defined Training

       SRD Sections
       4.0 Experiment Details
       5.0 Experiment Requirements

       MSAD Management Plan
       E2.3 Project and Mission Objectives

                       Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*1.1 Functional Objectives*)

topic '1.2 Equipment Identification'.
   window ('1.2 Equipment Identification', blue, white, white).
   say ('
     This section is referenced further in:

     SRD Section
     6.2 Apparatus Design Assistance

     MSAD Management Plan
     E2.5.2 System(s) and Subsystems

                 Press #fyellow SPACE#d to continue.').
   close_window ().
end.   (*1.2 Equipment Identification*)

topic '1.3 Operational Function Flows'.
   window('1.3 Operational Function Flows', blue,white,white,,,,13).
   say('
     This section is referenced further in:

     ERD Section
     8.0 Flight Software Requirements

     JA-003
     2.4 Interface Drawings and Functional Schematics

     JA-1303
     2.4 Interface Drawings and Functional Schematics

                 Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*1.3 Operational Function Flows*)

topic '3.2 Pointing/Stabilization and field-of-view requirements'.
   window ('3.2 Pointing/Stabilization and field-of-view requirements',bl
   say ('
     Only the highlighted sections are referenced further.

     3.2.1 Pointing Requirements
     #m3.2.2 Stability Requirements#m
     #m3.2.3 Field-of-View Requirements#m
     3.2.4 IPS Pointing Requirements
```

```
                Press #fyellow SPACE#d to continue.').
             close_window ().
    end.    (*3.2 Pointing/Stabilization and field-of-view requirements*)

    topic '3.3 Experiment Pointing and FOV Capabilities'.
       window ('3.3 Experiment Pointing FOV Capabilities',blue,white,white).
       say ('
            This section is referenced further in:

            ERD Section
            Viewing Requirements and Constraints (4.0)
                (Celestrial Viewing)

                    Press #fyellow SPACE#d to continue.').
       close_window ().
    end. (*3.3 Experiement Pointing and FOV Capabilities*)

    topic '3.4 Experiment On-Orbit acceleration and vibration limits'.
       window ('3.4 Experiment On-Orbit acceleration and vibration limits',bl
            white).
       say ('
            This section is referenced further in:

            ERD Section
            Vehicle Motion and g-Level Limits (4.0)

            SRD Sections
            5.4 Vibration Control and Measurements

                    Press #fyellow SPACE#d to continue').
       close_window ().
    end.    (*3.4 Experiment On-Orbit acceleration and vibration limits*)

    topic '3.5 Experiment Alignment and Coalignment Requirements'.
       window ('3.5 Experiment Alignment and Coalignment Requirements',blue,
            white,white).
       say ('
            This section is referenced further in:

            ERD Section
            9.1 Ground Integration Processing Flow and Definitions

                    Press #fyellow SPACE#d to continue').
             close_window ().
    end. (*3.5 Experiment Alignment and Coalignment Requirements*)

    (*------------  topic from section 4.0  --------------------*)

    topic 'Viewing Requirements and Constraints'.
       window ('Viewing Requirements and Constraints',blue,
            white,white).
       say ('
            This section is referenced further in:
```

```
                 ERD Section
                 3.2.3 Field of View Requirements
                 3.3 Experiment Pointing & FOV Capabilites

                       Press #fyellow SPACE#d to contiune.').
        close_window ().
end. (*Viewing Requirements and Constraints*)

topic  'Vehicle Motion and g-Level Limits'.
    window ('Vehicle Motion and g-Level Limits',blue,white,white).
    say ('
        This section is referenced further in:

        ERD Section
        3.4 Experiment On-Orbit Acceleration and Vibration Limits

               Press #fyellow SPACE#d to continue.').
        close_window ().
end. (* Vehicle Motion and g-Level Limits *)

(*-------------------------- end of topic from section 4.0  --------*)

topic '6.1 Heat transfer characteristics'.
    window ('6.1 Heat transfer characteristics',blue,white,white).
    say ('
        This section is referenced further in:

        SRD Section
        5.3 Temperature Control and Measurement

               Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*6.1 Heat transfer characteristics*)

topic '6.2 Fluid requirements'.
    window ('6.2 Fluid requirements',blue,white,white).
    say ('
        This section is referenced further in:

        SRD Sections
        5.2 Atmospheric Requirements
        6.2 Apparatus Design Assistance

               Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*6.2 Fluid requirements*)

topic '6.3 Ascent/Decent thermal control requirements'.
    window ('6.3 Ascent/Decent thermal control requirements',blue,white,
        white).
    say ('
        This section is referenced further in:

        SRD Sections
        5.2 Atmospheric Requirements
```

5.3 Temperature Control and Measurement

```
                Press #fyellow SPACE#d to continue:').
   close_window ().
end. (*6.3 Ascent/Decent thermal control requirements*)

topic '7.1 Payload Element to CDMS interfaces'.
   window ('7.1 Payload Element to CDMS interfaces',blue,white,white,,,,1
   say ('
       Each of these sections

       #mSignal Interface Definition#m
       #mSignal Interface Definition Expansion#m
       #mDisplay Requirements#m
       #mEvent/Exception Monitor Requirements#m
       #mDirect HRM, Analog, Video and MTU Requirements#m
       #mProcessed Dedicated HRM Channel Parameter Definition#m
       '#mPOCC Display Requirements#m
       #mPOCC Limit Sensing/Exception Monitor Requirements#m

       are referenced in :



       ERD Section
       11.3 PMM Defined Training

       and the highlighted sections are referenced further.


                Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*7.1 Payload Element to CDMS interfaces*)

topic '7.2 Caution and Warning'.
   window ('7.2 Caution and Warning',blue,white,white).
   say ('
     This section is referenced further in:

         #mSignal Interface Definition#m

            Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*7.2 Caution and Warning*)

topic '7.3 Error Messages Documentation'.
   window ('7.3 Error Messages Documentation',blue,white,white).
   say ('
       This section is referenced further in:

       ERD Sections

       11.1 PED/PI Defined Training
       11.2 PMM and PED/PI Jointly Defined Training
```

```
                        Press #fyellow SPACE#d to continue.').
      close_window ().
end.  (*7.3 Error Messages Documentation*)

   topic '9.1 Ground Integration processing flow and definitions'.
      window ('9.1 Ground Integration processing flow and definitions',blue,
      say ('
           Each of these sections

           #m9.1.1 Experiment/Facility Preintegration#m
           9.1.2 Experiment Integration
           #m9.1.3 Payload Integration#m
           #m9.1.4 Experiment Deintegration#m

           are referenced in:

           ERD Section
           3.5 Experiment Alignment and Coalignment Requirements

           and the highlighted sections are referenced further.

                        Press #fyellow SPACE#d to continue.').
      close_window ().
end.  (*9.1 Ground Integration processing flow and definitions*)

   topic '9.2 Experiment/Facility developer requirements definition'.
      window ('9.2 Experiment/Facility developer requirements definition',bl
      say ('
           The highlighted sections are referenced further.

           #m9.2.1 Experiment/Facility Preintegration#m
           #m9.2.2 Experiment/Facility Preparation#m
           #m9.2.3 Experiment User Room Requirements#m
           #m9.2.4 Experiment Late-Access Design Requirements#m
           #m9.2.5 Postmission Requirements#m
           #m9.2.6 Postmission Early-Access Requirements#m

                        Press #fyellow SPACE#d to continue.').
           close_window ().
end.  (*9.2 Experiment/Facility developer requirements definition*)

   topic 'Solids, Fluids, and Gases, Resource Requirements'.
      window ('Solids, Fluids, and Gases, Resource Requirements',blue,white,
           white).
      say ('
           This section is referenced further in:

           JSC Specifications SE-S-0073

                        Press #fyellow SPACE#d to continue.').
           close_window ().
end.  (*Solids, Fluids, and Gases, Resource Requirements*)

   topic '10.1 POCC Requirements'.
      window ('10.1 POCC Requirements',blue,white,white).
```

```
      say ('
           This section is referenced further in:

           JA-003
           8.3 POCC Requirements and Procedures

                   Press #fyellow SPACE#d to continue.').
         close_window ().
   end. (*10.1 POCC Requirements*)

   topic '10.2 Spaclab Data Processing Facility and Other Requirements'.
      window ('10.2 Spaclab Data Processing Facility and Other Requirements'
           blue, white, white).
      say ('
           This section is referenced further in:

           MSFC-STD-630

           JA-003
           8.4 Mission Data Processing

           JA-346

                   Press #fyellow SPACE#d to continue.').
      close_window ().
   end. (*10.2 Spaclab Data Processing Facility and Other Requirements*)

   topic '11.1 PED/PI Defined training'.
      window ('11.1 PED/PI Defined training',blue,white,white).
      say ('
           This section is referenced further in:

           ERD Section
           7.3 Error Messages Documentation

           SRD Section
           2.3 Brief Historical Account of Prior Research

                   Press #fyellow SPACE#d to continue.').
      close_window ().
   end. (*11.1 PED/PI Defined training*)

   topic '11.2 PMM and PED/PI jointly defined training'.
      window ('11.2 PMM and PED/PI jointly defined training',blue,white,whit
      say ('
           This section is referenced further in:

           ERD Section
           7.3 Error Messages Documentation

                   Press #fyellow SPACE#d to continue.').
         close_window ().
   end. (*11.2 PMM and PED/PI jointly defined training*)

   topic '11.3 PMM Defined training'.
```

```
   window ('11.3 PMM Defined training',blue,white,white).
   say ('
        This section is referenced further in:

        ERD Sections
        7.1 Payload Element to CDMS Interfaces Tables
        10.1 POCC Requirements

               Press #fyellow SPACE#d to continue.').
      close_window ().
end. (*11.3 PMM Defined training*)

topic '11.5 Training Participation'.
   window ('11.5 Training Participation',blue, white,white).
   say ('
        This section is referenced further in:

        ERD Section
        7.0 Data Systems Requirements

               Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*11.5 Training Participation*)


(*----------------- topic from section 12.0  -------------*)

topic '12.1 Flight Environment Limits'.
   window ('12.1 Flight Environment Limits',blue,white,white).
   say ('
        This section is referenced further in:

        SRD Section
        5.2 Atmospheric Requirements

                  Press #fyellow SPACE#d to continue.').
      close_window ().
end. (*12.1 Flight Environment Limits*)



(*========================= third level subtopics ===============*)

topic '3.2.2 Stability Requirements'.
   window ('3.2.2 Stability Requirements',blue,white,white).
   say ('
      This section is referenced further in:

      SRD Section
      5.4 Vibration Control and Measurement

                  Press #fyellow SPACE#d to continue.').
      close_window ().
end. (*3.2.2 Stability Requirements*)

topic '3.2.3 Field-of-View requirements'.
   window ('3.2.3 Field-of-View requirements',blue,white,white).
```

```
       say ('
            This section is referenced further in:

            ERD Section
            Viewing Requirements and Constraints (4.0)
               (Celestrial Viewing)

                            Press #fyellow SPACE#d to continue.').
       close_window ().
end. (*3.2.3 Field-of-View requirements*)

(*-------------------- topics for section 7.1  ------------*)
topic 'Signal Interface Definition'.
   window ('Signal Interface Definition',blue,white,white).
   say ('
        This section is referenced further in:

        MDC G6854
                        Press #fyellow SPACE#d to contiune.').
   close_window ().
end. (*Signal Interface Definition*)

topic 'Signal Interface Definition Expansion'.
   window ('Signal Interface Definition Expansion',blue,white,white).
   say ('
        This section is referenced further in:

        MDC G6854


           Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*Signal Interface Definition Expansion*)

topic 'Display Requirements'.
   window ('Display Requirements',blue,white,white).
   say ('
        This section is referenced further in:

        MDC G6854

             Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*Display Requirements*)

topic 'Event/Exception Monitor Requirements'.
   window ('Event/Exception Monitor Requirements',blue,white,white).
   say ('
        This section is referenced further in:

        MDC G6854

             Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*Event/Exception Monitor Requirements*)
```

```
topic 'Direct HRM, Analog, Video and MTU Requirements'.
  window ('Direct HRM, Analog, Video and MTU Requirements',blue,white,
       white).
  say ('
       This section is referenced further in:

       MDC G6854

                         Press #fyellow SPACE#d to continue. ').
  close_window ().
end. (*Direct HRM, Analog, Video and MTU Requirements*)

topic 'Processed Dedicated HRM Channel Parameter Definition'.
  window ('Processed Dedicated HRM Channel Parameter Definition',blue,
       white,white).
  say ('
       This section is referenced further in:

       MDC G6854

                         Press #fyellow SPACE#d to continue.').
  close_window ().
end. (*Processed Dedicated HRM Channel Parameter Definition*)

topic 'POCC Display Requirements'.
  window ('POCC Display Requirements',blue,white,white).
  say ('
       This section is referenced further in:

       JA-449
       Appendix A
       Appendix B
                         Press #fyellow SPACE#d to continue.').
  close_window ().
end. (*POCC Display Requirements*)

topic 'POCC Limit Sensing/Exception Monitor Requirements'.
  window ('POCC Limit Sensing/Exception Monitor Requirements',blue,white
       white).
  say ('
       This section is referenced further in:

       JA-449
       Appendix A
       Appendix B

                         Press #fyellow SPACE#d to continue.').
  close_window ().
end. (*POCC Limit Sensing/Exception Monitor Requirements*)

topic '9.1.1 Experiment/Facility Preintegration'.
  window ('9.1.1 Experiment/Facility Preintegration',blue,white,white).
  say ('
       This section is referenced further in:
```

```
                 SRD Section
                 4.5 Preflight Experiment Planned

                           Press #fyellow SPACE#d to continue.').
      close_window ().
end. (*9.1.1 Experiment/Facility Preintegration*)

topic '9.1.3 Payload Integration'.
   window ('9.1.3 Payload Integration',blue,white,white).
   say ('
      This section is referenced further in:

      JA-003
      6.1.2.3 Payload Integrated Testing
      8.1 Payload Integration

      JA-1303
      6.1.2.3 Payload Integrated Testing

                       Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*9.1.3 Payload Integration*)

topic '9.1.4 Experiment Deintegration'.
   window ('9.1.4 Experiment Deintegration',blue,white,white).
   say ('
      This section is referenced further in:

      SRD Section
      4.6 Post Flight Data Handling and Analysis

                   Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*9.1.4 Experiment Deintegration*)

topic '9.2.1 Experiment/Facility Preintegration'.
   window ('9.2.1 Experiment/Facility Preintegration',blue,white,white).
   say ('
        This section is referenced further in:

        SRD Section
        4.5 Prelight Experiment Planned

        MSAD Management Plan
        E2.5.3 Technology Plan

                     Press #fyellow SPACE#d to continue.').
      close_window ().
end. (*9.2.1 Experiment/Facility Preintegration*)

topic '9.2.2 Experiment/Facility Preparation'.
   window ('9.2.2 Experiment/Facility Preparation',blue,white,white,,,,1:
   say ('
      This section is referenced further in:
```

```
      SRD Sections
      4.1 Experiment Details
      4.3 Test Plan Including Ground Char. of Flight Hardware
      6.2 Apparatus Design Assistance

      MSAD Management Plan
      E2.5.3 Technology Plan

                     Press #Fyellow SPACE#d to continue.').
   close_window ().
end. (*9.2.2 Experiment/Facility Preparation*)

topic '9.2.3 Experiment User Room Requirements'.
   window ('9.2.3 Experiment User Room Requirements',blue,white,white).
   say ('
      This section is referenced further in:

      ERD Section
      7.0 Data System Requirements

      MSAD Management Plan
      E2.5.3 Technology Plan

                     Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*9.2.3 Experiment User Room Requirements*)

topic '9.2.4 Experiment Late-Access Design Requirements'.
   window ('9.2.4 Experiment Late-Access Design Requirements',blue,white,
      white,,,,12).
   say ('
      This section is referenced further in:

      SRD Section
      4.6 Post Flight Data Handling and Analysis

      IRN 130
      ICD-2-5A001
      ICD-2-0501
      SPAH
      MGSE MVAK
                     Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*9.2.4 Experiment Late-Access Design Requirements*)

topic '9.2.5 Postmission Requirements'.
   window ('9.2.5 Postmission Requirements',blue,white,white,,,,13).
   say ('
      This section is referenced further in:

      SRD Section
      4.6 Post Flight Data Handling and Analysis

      JA-003
      9.0 Post-Mission
```

```
                     Press #fyellow SPACE#d to continue.').
   close_window ().
end. (*9.2.5 Postmission Requirements*)

topic '9.2.6 Postmission Early-Access Requirements'.
   window ('9.2.6 Postmission Early-Access Requirements',blue,white,white
   say ('
      This section is referenced further in:

      SRD Section
      4.6 Post Flight Data Handling and Analysis

                     Press #fyellow SPACE#d to continue.').
      close_window ().
end. (*9.2.6 Postmission Early-Access Requirements*)

(*======================end third subtopic heading ===========*)
(*Last modifications: August 22, 1991*)
```

```
(*SRDOVER.KB      This program lists the outline for
(*                the Science Requirements Document.

do (soutline).
new_kb ('nasa.ckb').

topic soutline.
        say ('
    The primary purposes of the Science Requirements Document
    are:

    (1) to provide adequate justification for conducting the
    experiment in space,

    (2) to delineate and justify the science requirements that
    the experiment places on the hardware.


            The Outline for the Science Requirements Document:

                1. #mIntroduction/Summary#m

                2. #mBackground#m

                3. #mJustification for Conducting the Experiment in Space


                4. #mExperiment Details#m

                5. #mExperiment Requirements#m

                6. #mPrincipal Investigator''s Requirements#m

                7. #mOther Requirements#m

    The appropriate NASA official, for example the #mMSAD#m Chief Scientist,
    will have approval authority for the document and will be required
    to approve the original submission and all subsequent changes.').

    end. (* soutline*)
    (*==============================Threaded topics==================*)

    topic 'Introduction/Summary'.
        window ('Introduction/Summary',blue,white,white,,,,13).
        say ('
    Provide a brief discussion describing the following areas:

        #m1.1 Description of Experiment#m

        1.2 Scientific Knowledge to be Gained

        1.3 Value of Knowledge to Scientific Field

        1.4 Justification of the Need for Space Environment
```

```
                     Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*Introduction/Summary*)

topic 'Background'.
        window ('Background',blue, white,white,2,2,70,18).
        say ('
        Provide a brief discussion, between 300 and 900 words,
        describing the following areas:

   2.1 Description of Scientific Field to which the Experiment Belongs

   2.2 Current Application for Research in the Field

   #m2.3 Brief Historical Account of Prior Research#m

   #m2.4 Current Research#m

   2.5 Relationship of Proposed Experiment to Scientific Field

   2.6 Anticipated Advance in State of the Art

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*Background*)

topic 'Justification for Conducting the Experiment in Space'.
        window ('Justification for Conducting the Experiment in Space',blu
        white,white,3,4,70,16).
        say ('
        Provide a brief discussion describing the following areas:

        3.1 Limitations of Ground-Based Testing

        3.2 Limitations of Drop Towers

        3.3 Limitations of Testing in Aircraft

        3.4 Need for Accommodations in the Shuttle

        3.5 Limitations of Mathematical Modeling

        3.6 Limitations of Other Modeling Approaches

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end.  (*Justification for Conducting the Experiment in Space*)

topic 'Experiment Details'.
        window ('Experiment Details',blue,white,white,2,5,70,16).
        say ('
        Provide a detailed description of observational, measurement,
        environmental, and data requirements from which engineering
        specifications can be derived covering:
```

#m4.1 Experiment Procedures to be Used#m

4.2 Measurements Required

#m4.3 Test Plan Including Ground Characteristics of Flight Hardware#m

4.4 Specific Analysis Required

#m4.5 Preflight Experiment Planned#m

#m4.6 Post Flight Data Handling and Analysis#m

4.7 Mathematical Models Used

4.8 Application of Results

                Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Experiment Details*)

topic 'Experiment Requirements'.
        window ('Experiment Requirements',blue,white,white,2,5,70,13).
        say ('
      Provide a brief discussion describing the following areas:

        #m5.1 Experiment Sample Requirements#m

        #m5.2 Atmospheric Requirements#m

        #m5.3 Temperature Control and Measurement#m

        #m5.4 Vibration Control and Measurement#m

        #m5.5 Test Matrix#m

        #m5.6 Imaging Requirements#m

        #m5.7 Electromagnetic Limitations#m

        #m5.8 Astronaut Involvement#m

        #m5.9 Data Requirements#m

        #m5.10 Telepresence, Telerobotics#m

                Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Experiment Requirements*)

```
topic 'Principal Investigator''s Requirements'.
        window ('Principal Investigator''s Requirements',blue,white,white,
        15).
        say ('
     Provide a brief discussion describing the following areas:

            #m6.1 Research Equipment#m

            6.2 Apparatus Design Assistance

            6.3 Consultation

            6.4 Grant, Contract

            #m6.5 Services#m

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*Principal Investigator's Requirements*)

topic 'Other Requirements'.
        window ('Other Requirements',blue,white,white).
        say ('

     Describe other applicable material not addressed
     in the previous sections.

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (* Other Requirements *)

(*===========================the topics have subtopics ============*)

topic '1.1 Description of experiment'.
        window ('1.1 Description of experiment',blue,white,white,,,,13).
        say ('

     Indicate the number of flights involved and provide a brief
     description of each, including interdependent relationships
     and contingency plans.  Include summary descriptions and
     quantities of each major hardware system and subsystems.

     Summarize the essential guidelines for:

     Physical and functional compatibility between the experiment
     equipment and the Space Station Freedom environment.


     Physical and functional compatibility between the experiment
     equipment and interfacing flight systems and facilities.

     Physical and functional compatibility among experiments.

     Equipment and personnel safety.
```

4

```
                       Press #fyellow SPACE#d to continue.').
     close_window ().
end. (*1.1 Description of experiment*)

topic '2.3 Brief historical account of prior research'.
     window ('2.3 Brief historical account of prior research',blue,whit
     white).
     say ('


     This section summarizes previously conducted studies
     not including current research and results.


                         Press #fyellow SPACE#d to continue.         ').
     close_window ().
end. (*2.3 Brief historical account of prior research*)

topic '2.4 Current research'.
     window ('2.4 Current research',blue,white,white).
     say ('


     This section summarizes the most recently conducted studies
     or related activities and their results.

                         Press #fyellow SPACE#d to continue.         ').
     close_window ().
end. (*2.4 Current research*)

topic '4.1 Experiment procedures to be used'.
     window ('4.1 Experiment procedures to be used',blue,white,white).
     say ('

     Provide a incremental description of the steps that are to be
     preformed and include the resource requirements and time
     schedules for each step.

                         Press #fyellow SPACE#d to continue.').
     close_window ().
end. (*4.1 Experiment procedures to be used*)

topic '4.3 Test plan including ground characteristics of flight hardware
     window ('4.3 Test plan including ground character of hardware',blu
     white,white).
     say ('
     Include a discussion of the classification of the #mhardware#m
     (flight hardware reliability).

     The design of the flight hardware should strive to
     simplify/minimize the interfaces to and dependence on
     #mSTS#m/Spacelab systems.

                         Press #fyellow SPACE#d to continue.').
```

```
        close_window ().
end. (*4.3 Test plan including ground character of hardware*)

topic '4.5 Preflight experiment planned'.
        window ('4.5 Preflight experiment planned',blue,white,white,,,,13)
        say ('
The experiment will be sent to a Payload Integration Center
for preflight integration.  All interfaces with the Spacelab,
Orbiter, or Mission Peculiar Equipment (#mMPE#m) will be
functionally verified.  Provide #mGSE#m and operators required to
verify that the payload is functioning correctly prior to
integration.  The experimenter must also provide any required
operation procedures for verifying payload operability/
compatibility.

Define any of these activities that you will need.

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*4.5 Preflight experiment planned*)

topic '4.6 Post flight data handling and analysis'.
        window ('4.6 Post flight data handling and analysis',blue,white,wh
        say ('
Describe procedures and associated efforts, including
primary locations, for post-mission analysis of data and
other mission results.  Each developer is responsible for
data reduction, data analysis, publication of results and
preparation of necessary documentation for delivery to the
National Space Science Data Center at #mGSFC#m.

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*4.6 Post flight data handling and analysis*)

topic '5.1 Experiment sample requirements'.
        window ('5.1 Experiment sample requirements',blue,white,white).
        say ('


Be sure to include the number of samples and the materials
used to conduct the experiment.  Then make sure each one
is justified and/or substantiated in the documentation.

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.1 Experiment sample requirements*)

topic '5.2 Atmospheric requirements'.
        window ('5.2 Atmospheric requirements',blue,white,white,,,,13).
        say ('
Be sure to include any information related to:

Pressure
Gas Composition
```

Humidity
Vacuum

Then make sure each one is justified and/or substantiated
in the documentation.

                    Press #fyellow SPACE#d to continue. ').
        close_window ().
end. (*5.2 Atmospheric requirements*)

topic '5.3 Temperature control and measurement'.
        window ('5.3 Temperature control and measurement',blue,white,white
        say ('

As much accuracy as possible is required when describing
this section and each part must be justified and/or
substantiated in the documentation.

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.3 Temperature control and measurement*)

topic '5.4 Vibration control and measurement'.
        window ('5.4 Vibration control and measurement',blue,white,white).
        say ('
As much accuracy as possible is required, along with
the frequency of measurement when describing this section.

Each part must be justified and/or substantiated in the
documentation.

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.4 Vibration control and measurement*)

topic '5.5 Test matrix'.   .
        window ('5.5 Test matrix',blue,white,white).
        say ('

Include the number of tests and the required duration of
each test when describing this section. Each requirement
must be justified and/or substantiated in the documentation.

                    Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.5 Test matrix*)

topic '5.6 Imaging requirements'.
        window ('5.6 Imaging requirements',blue,white,white,2,5,70,14).
        say ('

Be sure to include any information related to:

```
                Photography
                Radiography
                Television
                Resolution
                Frame rate

        Each requirement must be justified and/or substantiated in
        the documentation.

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.6 Imaging requirements*)

topic '5.7 Electromagnetic limitations'.
        window ('5.7 Electromagnetic limit',blue,white,white,,,,15).
        say ('
Experiment equipment shall be designed and constructed to
meet the requirements of ICD 43004 section 3.4.2.8 and
MSFC-SPEC-521 to assure electromagnetic compatibility with
all Space Station Freedom equipment, #mSTS#m equipment, other
equipment and associated ground support equipment (#mGSE#m).

        (e.g., electric connections, power sources,
          safety critical emissions, and magnetic fields.)

        Each limitation must be justified and/or substantiated
        in the documentation.

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.7 Electromagnetic limit*)

topic '5.8 Astronaut involvement'.
        window ('5.8 Astronaut involvement',blue,white,white).
        say ('
Be sure to include any information related to:

        Extravehicular activity (EVA)

        Activation of experiment

        Each of the requirements must be justified and/or
        substantiated in the documentation.

                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.8 Astronaut involvement*)

topic '5.9 Data requirements'.
        window ('5.9 Data requirements',blue,white,white,,,,13).
        say ('
Define the requirements and activities for completing
the scientific data analysis and post flight reporting.
```

The developer shall submit stress and fracture control data on critical structures and bracketry in accordance with JA-418.

Each of the requirements must be justified and/or substantiated in the documentation.

```
                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.9 Data requirements*)

topic '5.10 Telepresence, telerobotics'.
        window ('5.10 Telepresence, telerobotics',blue,white,white).
        say ('
```

Each requirement must be justified and/or substantiated in the documentation.

```
                Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*5.10 Telepresence, telerobotics*)

topic '6.1 Research equipment'.
        window ('6.1 Research equipment',blue,white,white).
        say ('
```

Be sure to include any information related to:

    o Preflight

    o Postflight

```
                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*6.1 Research equipment*)

topic '6.5 Services'.
        window ('6.5 Services',blue,white,white).
        say ('
```

Be sure to include any information related to:

    o Film developing

    o Software development

```
                        Press #fyellow SPACE#d to continue.').
        close_window ().
end. (*6.5 Services*)

(*========================= end subtopics===================*)
```

```
(*                    NASA prototype system to aid in the                *)
(*                   development of NASA Science Requirements            *)
(*                  Documents for preflight planning and control.        *)

   topic 'experiment'.
     window ('Experiment ',blue,white,white).

      say ('

            That science activity which is going to be performed
            using a set of hardware.  This activity is defined
            by the Principal Investigator and leads to a set of
            science requirements which the #mhardware#m must meet
            in order to perform the experiment.

                    Press #fdarkgray SPACE#D to continue.').

     close_window ().
     end. (* experiment *)

   topic 'PI'.
     window ('Principal Investigator (PI)',blue,white,white,4,4,70,16).

      say ('


            The Principal Investigator is in charge of the conduct of
            the experiment and is responsible for defining the data or
            other products required/desired from the operation of an
            instrument or experiment facility (a payload element) and
            for providing scientific support during the physical
            integration and flight operation of the equipment.  This
            may include defining the performance requirements on
            equipment to be developed or may only be the definition
            of the use of existing equipment.  A PI may also be the
            Experiment Payload Element Developer (#mEPED#m).

                    Press #fdarkgray SPACE#D to continue.').
     close_window ().
     end. (* PI *)

   topic 'GSFC'.
     window ('GSFC',blue,white,white).

      say ('

        Goddard Space Flight Center

                    Press #fdarkgray SPACE#D to continue.').

     close_window ().
     end. (* PI *)

   topic 'MSAD'.
     window ('MSAD',blue,white,white).
```

1

```
        say ('

        Materials Summary Acceptance Document

                    Press #fdarkgray SPACE#D to continue.').
    close_window ().
    end.  (* MSAD *)

topic 'MPE'.
    window ('MPE',blue,white,white).

    say ('

        Mission Peculiar Equipment

                    Press #fdarkgray SPACE#D to continue.').

    close_window ().
    end.  (* MPE *)

topic 'GSE'.
    window ('GSE',blue,white,white).

    say ('

        Ground Support Equipment

                    Press #fdarkgray SPACE#D to continue.').

    close_window ().
    end.  (* GSE *)

topic 'EPED'.
    window ('EPED',blue,white,white).

    say ('

        Experiment Payload Element Developer

                    Press #darkgray SPACE#D to continue.').

    close_window ().
    end.  (* EPED *)

topic 'STS'.
    window ('STS',blue,white,white).

    say ('

        Space Transporation System

                    Press #darkgray SPACE#D to continue.').

    close_window ().
```

end. (* STS *)

3